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# ST. LAWRENCE RIVER PROJECT

# FINAL REPORT

# 1942

DOCUMENTS Room 8

## MISCELLANEOUS FEATURES

ANALYSES OF DESIGN
ESTIMATES OF COST
SUBSURFACE INVESTIGATIONS

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APPENDIX III-O(3)

U.S. Army, Corps of Engineers

# ST. LAWRENCE RIVER PROJECT

* * * * *

# FINAL REPORT

1942

## MISCELLANEOUS FEATURES

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U.S. Engineer Office - Massena, New York

July , 1942

APPENDIX III-O(3)

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# FEATURE NO. 1

# CHANNEL WORK, MILE 67 TO MILE 74,
# VICINITY OF GALOP ISLAND

# ESTIMATE OF COST

## FEATURE NO. 1 Channel Work, Mile 67 to Mile 74, Vicinity of Galop Island.

1. As stated in the main report, one of the principal purposes of excavation work covered by this feature is enlargement of the hydraulic capacity of the channels through this reach of the river. Local conditions are such as to require that the major portion of the spoil, except that used in constructing dikes, be placed on land in order to maintain the full hydraulic capacity of the channels. As a rule it will be necessary to use dipper dredges for removal of the material which is to be removed by dredging and placing the spoil on land above the water line or in dikes part of which will be above the water level. This will increase the cost of the work because of the higher cost of removal by dipper dredges as well as the cost of the extra handling in disposal on land above the water line.

2. A Break down of the estimated cost of this feature is given below. The estimate is based on the construction program outlined in Chapter III of the main report and any changes in that program may changes this estimate.

### ESTIMATED COST OF FEATURE NO. 1

### RECOMMENDED PLAN

| Item | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Cofferdams and unwatering | job. | | | $2,000,000 |
| 2 | Dry earth excavation | c.y. | 13,255,000 | $0.50 | 6,627,500 |
| 3 | Dry rock excavation | c.y. | 1,591,000 | 1.70 | 2,704,700 |
| 4 | Wet rock excavation | c.y. | 472,000 | 7.00 | 3,304,000 |
| 5 | Dipper dredging | c.y. | 7,229,000 | 0.75 | 5,421,750 |
| | | | 22,547,000 | | $20,057,950 |
| | Engineering and contingencies............... | | | | 5,014,250 |
| | Total............... | | | | $25,072,200 |

### ALTERNATE PLAN

| Item | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Dry earth excavation | c.y. | 16,655,000 | $0.50 | $8,327,500 |
| 2 | Dry rock excavation | c.y. | 4,597,000 | 1.70 | 7,814,900 |
| 3 | Wet rock excavation | c.y. | 1,412,000 | 7.00 | 9,884,000 |
| 4 | Dipper dredging | c.y. | 17,523,000 | 0.75 | 13,142,250 |
| 5 | Hydraulic dredging | c.y. | 2,500,000 | 0.35 | 875,000 |
| | | | 42,687,000 | | $40,043,650 |
| | Engineering and contingencies............ | | | | 10,010,850 |
| | Total............... | | | | $50,054,500 |

# FEATURE NO. 3

## CHANNEL WORK, MILE 74 TO MILE 76.5, SPARROWHAWK POINT CUT AND TOUSSAINTS ISLAND CUT

## ESTIMATE OF COST

## FEATURE NO. 3 - Channel Work, Mile 74 to Mile 76.5 - Sparrowhawk Point Cut and Toussaints Island Cut.

1. As stated in the main report, one of the principal purposes of the excavation work covered by this feature is enlargement of the hydraulic capacity of the channels through this reach of the river. Local conditions are such as to require that the major portion of the spoil, except that used in constructing dikes, be placed on land in order to maintain the full hydraulic capacity of the channels. As a rule, it will be necessary to use dipper dredges for removal of the material which is to be removed by dredging and placing the spoil on land above the water line or in dikes part of which will be above the water level. This will increase the cost of the work because of the higher cost of removal by dipper dredges as well as the cost of the extra handling in disposal on land above the water line.

2. A break down of the estimated cost of this feature is given below. The estimate is based on the construction program outlined in Chapter III of the main report and any changes in that program may change this estimate.

### ESTIMATED COST OF FEATURE NO. 3

| Item | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Dry earth excavation | c.y. | 7,614,000 | $0.50 | $3,807,000 |
| 2 | Dipper dredging | c.y. | 1,705,000 | 0.75 | 1,278,750 |
| | | | 9,319,000 | | $5,085,750 |
| | Engineering & contingencies | | | | 1,271,450 |
| | Total...................... | | | | $6,357,200 |

# FEATURE NO. 9

# RIVER WORK, MILE 79 TO MILE 85, BETWEEN POINT THREE POINTS AND CANADA ISLAND

## ESTIMATE OF COST

## FEATURE NO. 9 - River Work, Mile 79 to Mile 85, between Point Three Points and Canada Island.

1. As stated in the main report, one of the principal purposes of the excavation work covered by this feature is enlargement of the hydraulic capacity of the channels through this reach of the river. Local conditions are such as to require that the major portion of the spoil, except that used in constructing dikes, be placed on land in order to maintain the full hydraulic capacity of the channels. As a rule, it will be necessary to use dipper dredges for removal of the material which is to be removed by dredging and placing the spoil on land above the water line or in dikes part of which will be above the water level. This will increase the cost of the work because of the higher cost of removal by dipper dredges as well as the cost of the extra handling in disposal on land above the water line.

2. A break down of the estimated cost of this feature is given below. The estimate is based on the construction program outlined in Chapter III of the main report and any changes in that program may change this estimate.

### ESTIMATED COST OF FEATURE NO. 9

| Item | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Dry earth excavation | c.y. | 5,916,000 | $0.50 | $2,958,000 |
| 2 | Dry rock excavation | c.y. | 100,000 | 1.70 | 170,000 |
| 3 | Wet rock excavation | c.y. | 107,000 | 7.00 | 749,000 |
| 4 | Dipper Dredging | c.y. | 4,867,000 | 0.75 | 3,650,250 |
| | | | 10,990,000 | | $7,527,250 |
| | Engineering & contingencies........ | | | | 1,881,750 |
| | TOTAL................. | | | | $9,409,000 |

# FEATURE NO. 12

# RELOCATION OF UNITED STATES HIGHWAYS BETWEEN WADDINGTON AND MASSENA

## ANALYSIS OF DESIGN AND ESTIMATE OF COST

FEATURE NO. 12 - Relocation of United States Highways between Waddington and Massena.

## ANALYSIS OF DESIGN

### 1. INTRODUCTION

The St. Lawrence River Project development will flood portions of highway routes 37 and 37B between Waddington and Massena. This condition requires the relocation of parts of route 37B, and the raising of the existing grades and bridges on route 37 or relocation on higher ground to the south. The raising of existing grades and bridges on route 37 has been determined uneconomical because the terrain to the north and south of the highway will be flooded. It will be cheaper to construct the relocation over higher ground than to make large embankments and use flatter slopes and excessive rip rap over the existing route. The adopted relocation of route 37 will have a better alignment, eliminating all curves and one bridge.

### 2. ROUTE 37B

This highway must be relocated either on the new dikes or behind them. It has been considered undesirable to make a public highway of these dikes and it is thought that when surveys are completed, it will be found that the increased cost of embankment will more than offset any saving in grading operations. The plan regarding route 37B shortens the length to be relocated over the 238 - 242 plan. This is done by locating the Louisville dike north of route 37B except near Massena Canal Intake and by moving Bradford Point dike westward so as to leave the existing crossroad near it undisturbed. This crossroad will become part of route 37B, joining route 37 south of the dike.

### 3. ROUTE 37

Studies have been made of five possible relocations of this highway and it has been determined from these studies that the new route as shown on Drawing No. WHN-1-1/3, Appendix III - 0 (1) would be the best location and the most economical to construct. The five locations are shown on Drawing No. WHN-R-1/1, Appendix III-0(1). This road takes off from route 37 just east of Coles Creek and runs westerly practically on a tangent and joins state highway route No. 345 between Waddington and Madrid, a short distance south of Waddington. There are four bridges on the existing portion of the road to be relocated while on the adopted relocation route there are three. The adoption of this route eliminates the bridge at Sucker Brook. The cost of five different relocations have been estimated as follows: Adopted location (1) $ 507,000; and locations (2) $ 548,000; (3) $ 592,600; (4) $ 675,000; (5) $ 784,000. A comparative estimate of cost has been prepared for these various locations as listed. (See page 4)

## 4. EXPLORATIONS

Explorations were conducted for the purpose of determining overburden conditions at the various high roads fills and bridge sites between Waddington Route No. 345 and Coles Creek. The exploration consisted of geological reconnaissance, the excavation of test pits and auger holes and the drilling of one hole in overburden. The locations and records of the drill hole, tests pits, and auger holes are shown on Drawing No. WHN-12/1, Appendix III - 0(1).

## 5. BRIDGE SITE AT COLES CREEK

Exploration consisting of one drill hole and five test pits has shown the overburden in the valley bottom at the Coles Creek site to consist of 0 to 5.0 feet of silty sand underlain by compact silty and gravelly sand and the overburden in the abutments to consist of compact silty and gravelly sand. It is believed that little difficulty will be experienced in founding the bridge foundations in the valley bottom and that if a fill is placed, slopes of 1 on 1½ will be satisfactory.

## 6. FILL SITE ON TRIBUTARIES OF COLES CREEK

Exploration has revealed that the overburden in the valley bottom of the tributary located 1000 feet southwest of Coles Creek is firm material and fill slopes of 1 on 1½ were recommended at this location. The overburden in the valley bottom of the tributary 2500 feet southwest of the Coles Creek bridge site consist of soft clay to a depth of at least 12 feet. Because of this poor condition, fill slopes of 1 on 3 were recommended over this small area. However, with the use of rip rap on the north side of the road, wherever water is expected to be encountered, a slope of 1 on 2 has been adopted.

## 7. BRIDGE SITE AT BRANDY BROOK

Two test pits and two auger holes were excavated to explore this site. The overburden in the valley bottom and the abutments consist of firm material, generally a silty, gravelly sand. The hill which rises above the northeast abutment consist entirely of fine to medium sand which is quite compact.

## 8. BRIDGE SITE AT LITTLE SUCKER BROOK

One test pit was excavated in the valley bottom at the Little Sucker Brook site and this pit showed silty sand and gravel to exist 3.0 feet below the ground surface, the overburden in the valley may be considered as firm material.

## 9. RIGHT OF WAY.

Adoption of the new route was considered as the most economical and feasible. The relocation of routes 37 and 37B will require a new right of way over the relocated part of the highway.

## 10. USE OF EXISTING BRIDGES

Two of the four bridges on the existing route are steel construction. It seems feasible to move them to bridge sites on the new relocation.

## 11. ROAD MATERIALS INVESTIGATION

A complete report has been prepared on investigation of road materials and is on file in the District Files.

## 12. CONCRETE AGGREGATE INVESTIGATIONS

A Complete report has been prepared on investigation of concrete aggregates and is on file in the District Files.

## 13. CONCLUSION

The roads to be relocated are New York State highways. The design analysis and specifications for construction will conform to those of The Department of Public Works, Division of Highways, State of New York. The actual construction to be employed will provide roads as good as the existing roads. However, it was necessary to adopt some tentative plans for the purpose of comparative estimates of cost for various locations, therefore, the following construction was assumed: 22-foot wearing surface, 6-foot shoulders, 9-inch gravel foundation coarse, 4-inch bituminous penetration macadam bottom coarse, and 2-inch asphalt plant mix top coarse.

Discussions should be held with the District Engineer, District No. 7, Watertown, N. Y. before the plans are finally approved.

## ESTIMATE OF COST OF WADDINGTON - COLES CREEK HIGHWAY RELOCATION

### STUDY OF VARIOUS ROUTES

| Item | Designation | Unit | Unit Price | Location # 1 | | Location # 2 | | Location # 3 | | Location # 4 | | Location # 5 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Quantity | Cost | Quantity | Cost | Quantity | Cost | Quantity | Cost | Quantity | Cost |
| | Length | L.Ft. | | 30,374 | | 30,939 | | 30,187 | | 30,304 | | 28,320 | |
| 1 | Clearing and Grubbing | Sum | | Job | 3,250 | Job | 3,300 | Job | 3,220 | Job | 3,230 | Job | 3,000 |
| 2 | Excavation Roads | Cu.Yd. | .50 | 60,600 | 30,300 | 61,454 | 30,727 | 54,390 | 27,195 | 66,792 | 33,396 | 48,210 | 24,105 |
| 3 | Excavation Borrow | Cu.Yd. | .50 | 103,730 | 51,865 | 100,612 | 50,306 | 154,410 | 77,205 | 227,950 | 113,975 | 349,652 | 174,826 |
| 4 | Grade Crossing | Each | 250.00 | 2 | 500 | 2 | 500 | 1 | 250 | 1 | 250 | 1 | 250 |
| 5 | 24" R.C.P. Culvert | L.Ft. | 5.00 | 1,291 | 6,455 | 1,448 | 7,240 | 1,544 | 7,720 | 1,137 | 5,865 | 521 | 2,605 |
| 6 | 30" " " | L.Ft. | 8.00 | 156 | 1,248 | 156 | 1,248 | 238 | 1,904 | 161 | 1,288 | 164 | 1,312 |
| 7 | 36" " " | L.Ft. | 11.00 | 220 | 2,420 | 220 | 2,420 | 181 | 1,991 | 236 | 2,596 | 229 | 2,519 |
| 8 | 42" " " | L.Ft. | 15.00 | 427 | 6,405 | 230 | 3,450 | 394 | 5,910 | 227 | 3,405 | 63 | 945 |
| 9 | Dry Rip Rap | Cu.Yd. | 4.00 | 3,821 | 15,284 | 3,351 | 13,404 | 4,328 | 17,312 | 6,660 | 26,640 | 9537 | 38,148 |
| 10 | Portland Cement | Bbl. | 2.50 | 110 | 275 | 114 | 285 | 128 | 320 | 98 | 245 | 60 | 150 |
| 11 | Class A Concrete | Cu.Yd. | 25.00 | 79 | 1,975 | 76 | 1,900 | 85 | 2,125 | 65 | 1,625 | 41 | 1,025 |
| 12 | Guard Rail | L.Ft. | 1.25 | 8,356 | 10,445 | 8,246 | 10,307 | 12536 | 15,700 | 17,220 | 21,525 | 26,060 | 32,575 |
| 13 | Guide Post | Each | 2.50 | 192 | 480 | 196 | 490 | 212 | 530 | 160 | 400 | 100 | 250 |
| 14 | Foundation Course Compacted Measurement | Cu.Yd. | 1.80 | 24,750 | 44,550 | 25,210 | 45,378 | 24,597 | 44,275 | 24,689 | 44,440 | 23,080 | 41,544 |
| 15 | Regrading Foundation Course | Sq.Yd. | .20 | 74,248 | 14,850 | 75,628 | 15,126 | 73,790 | 14,758 | 74,067 | 14,813 | 69,226 | 13,845 |
| 16 | Bottom Course | Cu.Yd. | 4.50 | 8,250 | 37,125 | 8,403 | 37,814 | 8,199 | 36,896 | 8,289 | 37,301 | 7,700 | 34,650 |
| 17 | Top Course 2" | Sq.Yd. | .80 | 74,248 | 59,399 | 75,628 | 60,502 | 73,790 | 59,032 | 74,067 | 59,254 | 69,226 | 55,381 |
| 18 | Asphalt Bottom Course | Gal. | .15 | 148,496 | 22,275 | 151,256 | 22,688 | 147,580 | 22,137 | 148,134 | 22,220 | 138,400 | 20,760 |
| 19 | Bridge Cole Creek | Sum | | Job | 41,000 | Job | 41,000 | Job | 41,000 | Job | 53,000 | Job | 53,000 |
| 20 | " Little Sucker Brook | Sum | | Job | 20,900 | Job | 20,900 | Job | 25,200 | Job | 25,200 | Job | 33,500 |
| 21 | " Big Sucker Brook | Sum | | | | Job | 35,000 | Job | 35,000 | Job | 35,000 | Job | 47,000 |
| 22 | " Brandy Brook | Sum | | Job | 25,200 | Job | 25,200 | Job | 25,200 | Job | 25,200 | Job | 37,150 |
| 23 | R. of W., Acquiring Land | Acre | 200.00 | 46 | 9,200 | 47 | 9,400 | 46 | 9,200 | 46 | 9,200 | 43 | 8,600 |
| | | Total | | | 405,401 | | 438,585 | | 474,080 | | 540,068 | | 627,140 |
| | | Engineering and Contingencies 25%- | | | 101,599 | | 109,415 | | 118,520 | | 134,932 | | 156,860 |
| | | Total | | | $ 507,000 | | $ 548,000 | | $ 592,600 | | $ 675,000 | | $ 784,000 |

### TABLE OF COST

| | Distance Feet | Cost Per Foot | Cost Per Mile | Cost Without Bridges, Land, Eng. & Cont. | Cost of Bridges | Cost of Land | Total Exd. E.&C. | Eng. & Cont. 25% ± | Total Cost |
|---|---|---|---|---|---|---|---|---|---|
| Location No. 1 | 30,374 | $ 10.17 | $ 53,694 | $ 309,101 | $ 87,100 | $ 9,200 | $ 405,401 | $ 101,599 | $ 507,000 |
| Location No. 2 | 30,939 | 9.89 | 52,219 | 306,085 | 122,100 | 9,400 | 438,585 | 109,415 | 548,000 |
| Location No. 3 | 30,187 | 12.13 | 64,046 | 338,480 | 126,400 | 9,200 | 474,080 | 118,520 | 592,600 |
| Location No. 4 | 30,304 | 12.95 | 68,376 | 392,468 | 138,400 | 9,200 | 540,068 | 134,932 | 675,000 |
| Location No. 5 | 28,320 | 15.82 | 83,529 | 447,890 | 170,650 | 8,600 | 627,140 | 156,860 | 784,000 |

## ESTIMATED COST OF FEATURE NO. 12

### 1. Estimated Cost of Relocating Route 37

| Item | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Clearing and Grubbing | Sum | | Job | 3,250 |
| 2 | Excavation Roads | Cu.Yd. | 60,600 | .50 | 30,300 |
| 3 | Excavation Borrow | Cu.Yd | 103,730 | .50 | 51,865 |
| 4 | Grade Crossing | Each | 2 | 250.00 | 500 |
| 5 | 24" R.C.P. Culvert | L.Ft. | 1,291 | 5.00 | 6,455 |
| 6 | 30" " " | L.Ft. | 156 | 8.00 | 1,248 |
| 7 | 36" " " | L.Ft. | 220 | 11.00 | 2,420 |
| 8 | 42" " " | L.Ft. | 427 | 15.00 | 6,405 |
| 9 | Dry Riprap | Cu.Yd. | 3,821 | 4.00 | 15,284 |
| 10 | Portland Cement | Bbl. | 110 | 2.50 | 275 |
| 11 | Class A Concrete | Cu.Yd. | 79 | 25.00 | 1,975 |
| 12 | Guard Rail | L.Ft. | 8,356 | 1.25 | 10,445 |
| 13 | Guide Post | Each | 192 | 2.50 | 480 |
| 14 | Foundation Course Compacted Measurement | Cu.Yd. | 24,750 | 1.80 | 44,550 |
| 15 | Regarding Foundation Course | Sq.Yd. | 74,248 | .20 | 14,850 |
| 16 | Bottom Course | Cu.Yd. | 8,250 | 4.50 | 37,125 |
| 17 | Top Course 2" | Sq.Yd. | 74,248 | .80 | 59,399 |
| 18 | Asphalt Bottom Course | Gal. | 148,496 | .15 | 22,275 |
| 19 | Bridge Cole Creek | Sum | 1 | Job | 41,000 |
| 20 | " Little Sucker Brook | Sum | 1 | Job | 20,900 |
| 21 | Bridge Brandy Brook | Sum | 1 | Job | 25,200 |
| 22 | R. of W., Acquiring Land | Acre | 46 | 200.00 | 9,200 |
| | TOTAL | | | | 405,401 |
| | Engineering and Contingencies 25% | | | | 101,599 |
| | TOTAL COST OF RELOCATING ROUTE 37 | | | | $507,000 |

### 2. Estimated Cost of Relocating Route 37B

| | | | |
|---|---|---|---|
| 1. | Length of relocation Route 37B | | 21,600 feet |
| 2. | Unit price per foot based on relocation of Route 37 to South Route | | $10.17 per foot |
| 3. | Cost of relocating Route 37B, 21,600 x $10.17 = | $265,437 | |
| 4. | 40 Acres of land at $200 per acre = | 8,000 | |
| | TOTAL | 273,437 | |
| | Engineering and Contingencies 25% | 68,563 | |
| | TOTAL COST OF RELOCATING ROUTE 37B | $342,000 | |

### 3. Estimated Cost of Relocating both Routes 37 and 37B

| | |
|---|---|
| Route 37 | $507,000 |
| Route 37B | 342,000 |
| TOTAL COST OF FEATURE NO. 12 | $849,000 |

# FEATURE NO. 14

# DIKES ON UNITED STATES SIDE BETWEEN WADDINGTON AND CROIL ISLAND

# ESTIMATE OF COST

## FEATURE NO. 14 - Dikes on United States Side between Waddington and Croil Island

The estimated cost of the Coles Creek, Bradford Point and Louisville Landing Dikes is as follows:

a. COLES CREEK DIKE

| | | | |
|---|---|---|---|
| 4,500 Cubic Yards dumped earth fill | at $0.30 | = | $ 1,350 |

b. BRADFORD POINT DIKE

| | | | |
|---|---|---|---|
| 190,000 Cubic Yards compacted earth fill | at .50 | = | 95,000 |
| 37,500 Cubic Yards riprap | at 2.00 | = | 75,000 |
| 27,500 Cubic Yards sand and gravel | at 1.00 | = | 27,500 |
| 10,000 Cubic Yards stripping and excavation | at .50 | = | 5,000 |
| | | | $202,500 |

c. LOUISVILLE LANDING DIKES

No. 1

| | | | |
|---|---|---|---|
| 14,700 Cubic Yards compacted earth | at .50 | = | 7,350 |
| 4,900 Cubic Yards riprap | at 2.00 | = | 9,800 |
| 1,400 Cubic Yards sand and gravel | at 1.00 | = | 1,400 |
| 2,100 Cubic Yards stripping and excavation | at .50 | = | 1,050 |
| | | | 19,600 |

No. 3

| | | | |
|---|---|---|---|
| 400,000 Cubic Yards compacted earth | at .50 | = | 200,000 |
| 52,000 Cubic Yards riprap | at 2.00 | = | 104,000 |
| 20,000 Cubic Yards sand and gravel | at 1.00 | = | 20,000 |
| 25,000 Cubic Yards stripping and excavation | at .50 | = | 12,500 |
| | | | $336,500 |

No. 4

| | | | |
|---|---|---|---|
| 10,500 Cubic Yards compacted earth | at .50 | = | 5,250 |
| 3,500 Cubic Yards riprap | at 2.00 | = | 7,000 |
| 1,000 Cubic Yards sand and gravel | at 1.00 | = | 1,000 |
| 1,500 Cubic Yards stripping and excavation | at .50 | = | 750 |
| | | | $14,000 |

No. 5

| | | | |
|---|---|---|---|
| 10,500 Cubic Yards compacted earth | at .50 | = | 5,250 |
| 3,500 Cubic Yards riprap | at 2.00 | = | 7,000 |
| 1,000 Cubic Yards sand and gravel | at 1.00 | = | 1,000 |
| 1,500 Cubic Yards stripping and excavation | at .50 | = | 750 |
| | | | $14,000 |

| | |
|---|---|
| Total | $587,950 |
| Engineering and Contingencies @ 25% | 147,050 |
| TOTAL COST OF FEATURE NO. 14 | $735,000 |

## FEATURE NO. 28

# NEW CORNWALL CANAL LOCK, GUARD GATE AND PART OF ATTACHED DIKES

## ESTIMATE OF COST

## FEATURE NO. 28 - New Cornwall Canal Lock, Guard Gate, and Part Of Attached Dikes.

### 1. Estimated Cost of New Cornwall Canal Lock and Guard Gate Structures

| Item | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Concrete | Cu.Yd. | 383,000 | 11.10 | $4,251,300 |
| 2 | Excavation earth | Cu.Yd. | 656,000 | .50 | 328,000 |
| 3 | Excavation rock | Cu.Yd. | 25,330 | 2.50 | 63,325 |
| 4 | Backfill | Cu.Yd. | 212,000 | .40 | 84,800 |
| 5 | Lock Gates | | 3 Pr. Mitre | | 184,000 |
| 6 | Guard Gates | | 1 Pr. Sector | | 36,000 |
| 7 | Stop-log Structure | | L. S. | | 50,000 |
| 8 | Sluice Gates, Hoist | | L. S. | | 70,000 |
| 9 | Stop-logs Structures | | L. S. | | 40,000 |
| 10 | Tenders, Capstans Lightning Equipment | | L. S. | | 167,000 |
| 11 | Control Sta. building and grounds | | L. S. | | 100,000 |
| | Total | | | | 5,374,425 |
| | Engineering and Contingencies @ 21% | | | | 1,125,575 |
| | TOTAL COST OF LOCK AND GUARD GATE STRUCTURES | | | | $6,500,000 |

## 2. Estimated Cost of Part of Attached Dikes.

| Item | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Fill, Earth Compacted | Cu.Yd. | 416,000 | .12 | $ 49,920 |
| 2 | Rock Toes | Cu.Yd. | 96,000 | 2.50 | 240,000 |
| 3 | Excavation | Cu.Yd. | 30,000 | .35 | 10,500 |
| 4 | Sand and Gravel Filter | Cu.Yd. | 26,000 | 2.00 | 52,000 |
| 5 | Riprap, Class B | Cu.Yd. | 20,000 | 1.50 | 30,000 |
| 6 | Riprap, Class A | Cu.Yd. | 12,000 | 2.00 | 24,000 |
| 7 | Sand and Gravel Backing | Cu.Yd. | 12,000 | 1.75 | 21,000 |
| | Total | | | | 427,420 |
| | Engineering and Contingencies @ 21% | | | | 92,580 |
| | TOTAL COST OF PART OF ATTACHED DIKES | | | | $520,000 |

### SUMMARY

| | |
|---|---|
| 1. Estimated Cost of Lock and Guard Gate Structures | $6,500,000 |
| 2. Estimated Cost of Part of Attached Dikes | 520,000 |
| TOTAL COST OF FEATURE NO. 28 | $7,020,000 |

# FEATURE NO. 29

## ACCESS ROUTES TO THE BARNHART ISLAND POWERHOUSE FROM THE CANADIAN SIDE

## ESTIMATE OF COST

## FEATURE NO. 29 - Access Routes to the Barnhart Island Powerhouse from the Canadian Side.

### a. Estimated Cost of Access Railway and Highway to Canadian Powerhouse

| Item | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Trackage | L.Ft. | 14,100 | 5.00 | $70,500 |
| 2 | Pavement | Sq.Yd. | 10,820 | 2.50 | 27,050 |
| 3 | Gravel; Shoulders | Sq.Yd. | 5,400 | 1.75 | 9,450 |
| 4 | Excavation; Common | Cu.Yd. | 8,000 | .50 | 4,000 |
| 5 | Embankment | Cu.Yd. | 146,000 | .30 | 43,800 |
| 6 | Sand and Gravel Blanket | Cu.Yd. | 1,200 | 3.00 | 3,600 |
| 7 | Riprap | Cu.Yd. | 2,300 | 3.00 | 6,900 |
| 8 | Embankment (between bridges) | Ea. | 1 | L.S. | 5,000 |
| | Total | | | | $170,300 |
| | Engineering and Contingencies 18% | | | | 30,700 |
| | TOTAL COST OF ACCESS RAILWAY AND HIGHWAY TO CANADIAN POWERHOUSE | | | | $201,000 |

### b. Estimated Cost of Bridges on Access Routes

Swing Span

| Item | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Machinery | Lb. | 100,000 | .45 | $45,000 |
| 2 | Steel; Structural | Lb. | 883,200 | .10 | 88,320 |
| 3 | Steel; Reinforced Conc. | Lb. | 21,900 | .065 | 1,424 |
| 4 | Concrete | Cu.Yd. | 800 | 25.00 | 20,000 |
| 5 | Counterweight | Cu.Yd. | 225 | 80.00 | 18,000 |
| 6 | Decking; Road | Sq.Ft. | 3,160 | 6.00 | 18,960 |
| 7 | Decking; Walk | Sq.Ft. | 700 | 2.00 | 1,400 |
| 8 | Track and Ties | L.Ft. | 178 | 3.00 | 534 |
| 9 | Guard Rail | L.Ft. | 350 | 2.00 | 700 |
| 10 | Piles | L.Ft. | 540 | 2.50 | 1,350 |
| | | | Subtotal | | $195,708 |

Fixed Span

| Item | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Steel; Structural | Lb. | 736,000 | .10 | 73,600 |
| 2 | Steel; Reinforced Conc. | Lb. | 14,700 | .065 | 955 |
| 3 | Concrete | Cu.Yd. | 380 | 25.00 | 9,500 |
| 4 | Decking; Road | Sq.Ft. | 3,370 | 6.00 | 20,220 |
| 5 | Decking; Walk | Sq.Ft. | 750 | 2.00 | 1,500 |
| 6 | Track and Ties | L.Ft. | 160 | 3.00 | 480 |
| 7 | Guard Rail | L.Ft. | 320 | 2.00 | 640 |
| 8 | Piles | L.Ft. | 310 | 2.50 | 775 |
| | | | Subtotal | | 107,670 |

|  |  |
|---|---|
| Total | $303,378 |
| Engineering and Contingencies 21% | 63,622 |
| TOTAL COST OF BRIDGES ON ACCESS ROUTES | $367,000 |

SUMMARY

|  |  |  |
|---|---|---|
| a. | Estimated cost of Access Railway and Highway to Canandian Powerhouse | $201,000 |
| b. | Estimated cost of Bridges on Access Routes | 367,000 |
|  | TOTAL COST OF FEATURE NO. 29 | $568,000 |

# FEATURE NO. 33

# IMPROVEMENT IN SOUTH CHANNEL BELOW MILE 107.4

## ESTIMATE OF COST

## FEATURE NO. 33 - Improvement in South Channel Below Mile 107.4

1. The estimate of cost for this feature is based on the premise that the excavation will be done by dipper dredges and the spoil deposited in deep water in Lake St. Francis off Hopkins Point as indicated on Plate I. The operations are based on the construction program outlined in Chapter III of the main report, and any changes in that program may change this estimate. A breakdown of this estimate is given below which includes the excavation at the mouth of Grass River exclusive of the entrance channel.

### ESTIMATED COST OF FEATURE NO. 33

| Item | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Dry excavation | c.y. | 1,865,000 | $0.50 | $ 932,500 |
| 2 | Dipper dredging, ordinary | c.y. | 1,209,000 | 0.75 | 906,750 |
| 3 | Dipper dredging, swift water | c.y. | 3,632,000 | 1.05 | 3,813,600 |
| | | | 6,706,000 | | $5,652,850 |
| | Engineering & contingencies | | | | 1,413,150 |
| | Total | | | | $7,066,000 |

# FEATURE NO. 34

# CORNWALL CHANNEL ENLARGEMENT, MILE 108 TO MILE 110

# ESTIMATE OF COST

## FEATURE NO. 34 - Cornwall Channel Enlargement, Mile 108.0 to 110.0

1. The estimate of cost for this feature is based on the premise that the excavation will be done by dipper dredges and the spoil deposited in deep water in Lake St. Francis off Hopkins Point as indicated on Plate I. The operations are based on the construction program outlined in Chapter III of the main report, and any changes in that program may change this estimate. A breakdown of this estimate is given below which includes the excavation at the mouth of Grass River exclusive of the entrance channel.

### ESTIMATED COST OF FEATURE NO. 34

| Item | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Dipper dredging, ordinary | c.y. | 960,000 | $0.75 | $ 720,000 |
| 2 | Dipper dredging, swift water | c.y. | 1,096,400 | 1.05 | 1,151,220 |
| | | | 2,056,400 | | $1,871,220 |
| | Engineering & contingencies............... | | | | 467,780 |
| | Total........................ | | | | $2,339,000 |

# FEATURE NO. 35

# RELOCATION OF NEW YORK CENTRAL RAILROAD (OTTAWA DIVISION) AND ROOSEVELT BRIDGE HIGHWAY

## ANALYSIS OF DESIGN AND ESTIMATE OF COST

## FEATURE NO. 35 - Relocation of New York Central Railroad (Ottawa Division) and Roosevelt Bridge Highway

## ANALYSIS OF DESIGN

### 1. INTRODUCTION

The construction of a deep waterway as part of the St. Lawrence River Seaway and Power Development project entails the building of a canal through the southern part of Cornwall Island or improving the south channel of the river, either of which would cross the existing New York Central - Ottawa Division - Railroad and Roosevelt Bridge Highway at or near the South Channel Roosevelt Bridge. This would necessitate either building a new South Channel bridge of such design or elevation that it would not interfere with navigation, or relocating the railroad and highway on a route that would cross the new canal at a more favorable location.

### 2. PLAN STUDIED

A study of the situation produced the following conclusions:

(a) A new bridge with a lift span over the canal adjacent to the site of the existing South Channel bridge would inaugurate a menace to navigation due to the fact that the estimated 4 mi. per. hr. current in the canal at that point would make it difficult for a boat to stop in the event that the lift mechanism failed to function.

(b) The cost of replacing the present South Channel bridge with a new high level bridge providing 125' clearance would be excessive.

(c) Crossing the canal could be accomplished by means of a bobtail swing bridge at the Grass River Lock where the span would be short; the velocity of the water would be under control; and boats must stop regardless of the bridge.

### 3. PLAN ADOPTED

It was decided from these conclusions that the most practical procedure is to relocate the railroad on a route beginning at the north end of the Raquette River bridge and proceeding west and north across Grass River, Grass River Lock and dikes, thence east across Pollys Gut to Cornwall Island, making connection with the existing railroad approximately 1/4 mile south of the existing North Channel Roosevelt bridge. The highway relocation begins at a point 2350 feet north of Raquette River bridge. New road construction is proposed for the first 2520 feet to the west to a junction with an existing road. This was found to be more economical than widening the existing road from the Raquette River bridge which follows a circuitous route to the junction. From this point the existing road is to be improved to the vicinity of the proposed Grass River bridge, thence paralleling the railroad most of the distance to its end. The junction of the new highway with the existing Roosevelt bridge highway on Cornwall Island will be determined after surveys have been made but for the present it is tentatively fixed at a point about 1/2 mile south of the North Channel bridge.

## 4. BRIDGES

In connection with the relocation it is necessary to build three bridges; one fixed deck bridge 996 feet long at Grass River, one swing bridge 90 feet long at Grass River Lock and one fixed bridge 840 feet long at Pollys Gut. All three bridges will have combined highway and railroad roadbeds which arrangement obtains at the present Roosevelt bridge.

## 5. RAILROAD RELOCATION

A field survey of the approximate route of the railroad relocation from the Raquette River bridge to Pollys Gut provided the data from which the final route was evolved after several studies had indicated the most economical location in regard to gradient and alignment.

These studies presupposed the following locations:

(a) Between the adopted alignment and the previously mentioned existing highway to be widened, involving 229,000 C.Y. excavation.

(b) North of the same existing highway involving 68,000 C.Y. excavation. This location involved the least amount of earthwork but required a bridge across Grass River 80' longer than in the other studies.

(c) Considerably south of the existing highway. Three locations were considered in this area varying only slightly in position and excavation involved. Since their length varied by only a few feet, the line requiring the least excavation (98,000 C.Y.) was finally adopted. The choice of alignment north of Grass River was governed to a great extent by the position of the Grass River Lock Dike and the economic necessity for a minimum length bridge across Pollys Gut. Two studies were made in this connection. In each the alignment was nearly at right angles to the Grass River Lock Dike, continuing in a tangent across Pollys Gut to the existing railroad. The two alignments were parallel and about 400 feet apart, the north line finally being chosen because its slightly greater length was more than balanced by a saving of 4000 C.Y. of embankment and less damage to homes on Cornwall Island.

## 6. HIGHWAY ALIGNMENT

The highway alignment from the Grass River Lock dike to Pollys Gut was governed by the position of the new railroad as well as by the fact that a large area north of the new canal will be utilized as a spoil bank for material taken from the canal which tests have shown to be unsuitable to support a highway built over its surface. In regard to alignment on Cornwall Island, the fact that the deck of Pollys Gut bridge will be, for clearance purpose, considerably higher than the ground in the immediate vicinity, influenced the decision to align the highway as close to the railroad as possible, thereby utilizing the railroad embankment to a great extent.

## 7. GRADES

After combining the general basis of design for the existing railroad with a proper regard for the factor of economy it was decided that the maximum gradient for the railroad relocation should not exceed 0.7% and the maximum degree of curvature should not exceed 7 degrees. The maximum gradient for the highway relocation, in conformity to modern practice, was held to approximately 4%. These limiting factors were recognized throughout the design.

## 8. DESIGN PROCEEDURE

The actual construction to be employed will provide roads as good as the existing roads. However, it was necessary to adopt some tentative plans for the purpose of comparative estimates of cost for various locations, therefore the following construction was assumed:

For railroad - 90 lb. rails on 8" x 6" x 8' - 0" ties with 12" stone ballast beneath the ties except on the dike where the quality and compaction of the embankment warrant the use of 6" ballast.

For highway - 22 foot wearing surface composed of 9" gravel foundation course, 4" bituminous penetration macadam bottom course and 2" asphalt plant-mix top course. 6 foot shoulders except on fills of more than 3 feet employing 7.5 foot shoulders and guard rail.

## 9. USE OF EXISTING HIGHWAY AND RAILROAD AND SALVAGING

It is anticipated that the existing railroad and highway will remain in use until the construction of the relocation is completed, at which time the switch-over can be easily accomplished and the unneeded sections salvaged and abandoned. In this connection it is planned to remove and if possible salvage the South Channel Roosevelt bridge as soon as the relocation is completed and in any event before navigation is directed through the new Long Sault Canal.

## 10. ALTERNATE

If the project is developed for power only, it will not be necessary to relocate the railroad and highway.

## ESTIMATE OF COST OF FEATURE NO. 35

### NEW YORK CENTRAL R. R. (OTTAWA DIVISION) RELOCATION

| Item No. | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Excavation (Earth-R.R.) | c.y. | 190000* | .50 | $95000 |
| 2 | Fill (Earth-R.R.) | c.y. | 166000 | .12 | 19920 |
| 3 | Reinf. Conc. pipe 24" dia. | l.f. | 300 | 5.00 | 1500 |
| 4 | " " " 30" " | l.f. | 200 | 8.00 | 1600 |
| 5 | Conc. Hdws. for 24" pipe | each | 12 | 35.00 | 420 |
| 6 | " " " 30" " | each | 8 | 40.00 | 320 |
| 7 | Ballast | c.y. | 11000 | 2.50 | 27500 |
| 8 | Furnishing Rails and Accessories | l.f. | 21500 | 1.80 | 38700 |
| 9 | Laying Track | l.f. | 21500 | 1.50 | 32250 |
| 10 | Ties | each | 11600 | 2.00 | 23200 |
| 11 | Grade Crossing | each | 3 | 250.00 | 750 |
| 12 | Clearing and Grubbing | job | | | 2800 |
| 13 | Acquiring R. O. W. | acre | 27 | 200.00 | 5400 |
| 14 | R. O. W. Fence | l.f. | 32000 | .50 | 16000 |
| | Total | | | | $265360 |
| | Add Engineering and Contingencies 21% | | | | 55640 |
| | TOTAL COST OF RELOCATION OF NEW YORK CENTRAL R. R. (OTTAWA DIV.) | | | | $321000 |

Cost per mile: $\frac{321000}{4.07} = \$79{,}000$

* Includes material from borrow

## ROOSEVELT BRIDGE HIGHWAY RELOCATION

| Item No. | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Excavation (Earth-Hwy.) | c.y. | 64000 | .50 | $32000.00 |
| 2 | Fill (Earth-Hwy.) | c.y. | 55000 | .12 | 6600.00 |
| | Reinf. conc. pipe 24" dia. | l.f. | 600 | 5.00 | 3000.00 |
| | Conc. headwalls for 24" R.C.P. | each | 30 | 35.00 | 1050.00 |
| 3 | Gravel fill base (found. course) | c.y. | 10000 | 1.80 | 18000.00 |
| 4 | Regarding Foundation Course | s.y. | 39000 | .20 | 7800.00 |
| 5 | Bottom Course (4" Bit. pen. mac.) | c.y. | 4500 | 4.50 | 20250.00 |
| 6 | Asphalt Binder | gal. | 80000 | .15 | 12000.00 |
| 7 | Top Course-2" plant mix | s.y. | 49000 | .80 | 39200.00 |
| 8 | Fine Grading | s.y. | 100 | .20 | 20.00 |
| 9 | Seeding | acre | 1 | 250.00 | 250.00 |
| 10 | Conc. Pav't. (Br. approaches) | c.y. | 20 | 25.00 | 500.00 |
| | Metal Reinf. for conc. pav't. | s.y. | 100 | .30 | 30.00 |
| 11 | Guard Rail | l.f. | 7000 | 1.25 | 8750.00 |
| 12 | Clearing and Grubbing | job | | | 2000.00 |
| 13 | Acquiring R. O. W. | acre | 6 | 200.00 | 1200.00 |
| 14 | Guide Posts | each | 60 | 2.50 | 150.00 |
| | Total | | | | $152800.00 |
| | Add Engineering and Contingencies 21% | | | | 32200.00 |
| | TOTAL COST OF RELOCATION OF ROOSEVELT BRIDGE HWY. | | | | $185000.00 |

Cost per mile = $\frac{185000}{3.75} = \$49.500$

## SUMMARY

| | | |
|---|---|---|
| 1. | New York Central R. R. (Ottawa Div.) Relocation. | $321,000 |
| 2. | Roosevelt Bridge Highway Relocation. | 185,000 |
| | TOTAL COST OF FEATURE NO. 35 | $506,000 |

# FEATURE NO. 36

# RELOCATION OF TRANSMISSION LINES
# OF THE ST. LAWRENCE RIVER POWER CO.

# ESTIMATE OF COST

## FEATURE NO. 36 - Relocation of transmission lines of the St. Lawrence River Power Co.

### a. Estimated Cost of Raising Transmission Line at Robinson Bay Lock.

| Item | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Conductor; (7200 ft. Aluminum if available + 13470 Copper) | L. Ft. | 20,670 | $ .28 | $ 5,760 |
| 2 | Towers; Steel; Furnish and Erect | Lb. | 140,000 | .12 | 16,800 |
| 3 | Wood Pole with Cross; Arm | Ea. | 2 | 100.00 | 200 |
| 4 | Insulators and Miscellaneous; Towers with Dead End. | Ea. | 2 | 1030.00 | 2,060 |
| 5 | Ground Wire (½strand steel); Furhish and Erect. | L. Ft. | 3,100 | .06 | 186 |
| 6 | Concrete Base | Cu.Yd. | 300 | 10.00 | 3,000 |
| 7 | Excavation | Cu.Yd. | 1,200 | 1.00 | 1,200 |
| | | | | Subtotal | $29,206 |
| 8 | Temporary Work | | | | |
| | a. Wood Pole Towers | Ea. | 15 | $40.00 | $ 600 |
| | b. Guy Wire | M. Ft. | 4,000 | 40.00 | 160 |
| | c. Erecting Conductors | L. Ft. | 21,000 | .09 | 1,890 |
| | | | | Subtotal | $2,650 |
| | Totals ($29,206 + $2,650) = | | | | $31,856 |
| | Engineering and Contingencies 21% | | | | 7,144 |
| | TOTAL COST OF RAISING TRANSMISSION LINE AT ROBINSON BAY LOCK | | | | $39,000 |

### b. Estimated Cost of Forebay Relocation

| Item | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Conductor (350,000 C. M. Copper); Furnish and Erect | L. Ft. | 94,590 | $ .28 | $26,500 |
| 2 | Ground Wire (½" strand steel); Furnish and Erect | L. Ft. | 20,960 | .06 | 1,260 |
| 3 | Towers; steel; Furnish and Erect | Lbs. | 274,000 | .12 | 32,800 |

b. Estimated Cost of Forebay Relocation (Cont'd.)

| Item | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 4 | Concrete Base in Forebay | Cu. Yd. | 2,000 | $15.00 | $30,000 |
| 5 | Concrete Base Outside Forebay; Lock and Wall Extension on Cornwall Dike | Cu. Yd. | 410 | 10.00 | 4,100 |
| 6 | Insulators and Miscellaneous | | | | |
| | a. Suspension Towers | Ea. | 4 | 305.00 | 1,220 |
| | b. Angle Towers | Ea. | 6 | 515.00 | 3,090 |
| 7 | Excavation | Cu. Yd. | 4,800 | 1.00 | 4,800 |
| | Total | | | | $103,770 |
| | Engineering and Contingencies 21% | | | | 21,230 |
| | TOTAL COST OF FOREBAY RELOCATION | | | | $125,000 |

SUMMARY

| | | |
|---|---|---|
| a. | Estimated Cost of Raising Transmission Line at Robinson Bay Lock | $ 39,000 |
| b. | Estimated Cost of Forebay Relocation | 125,000 |
| | TOTAL COST OF FEATURE NO. 36 | $164,000 |

# ACCESS AND RELOCATION BRIDGES

## ANALYSIS OF DESIGN

(Pertains to Features 12, 21, 29 and 35)

ST. LAWRENCE RIVER PROJECT

ACCESS AND RELOCATION BRIDGES

## ANALYSIS OF DESIGN

Index of Sections

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# ST. LAWRENCE RIVER PROJECT

## ACCESS AND RELOCATION BRIDGES

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## ANALYSIS OF DESIGN

### List of Plates

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| V-1 | New York Central Railroad Relocation Bridge No. 1 - Crossing Grass River |
| V-2 | New York Central Railroad Relocation Bridge No. 3 - Crossing Polly's Gut |
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| V-4 | Channels and Cuts - Plan of Exploration - Vicinity of Cornwall Island - No. 1 |
| V-5 | Highway Relocation - Plan and Record of Exploration - Bridge Sites, Vicinity of Waddington |
| V-6 | Grass River Bridge Sites - Plan and Profiles - Soils and Foundation Exploration |
| VI-1 | New York Central Railroad - Ottawa Division - Relocation - Location Map |
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| X-2 | Access Highway - Bridge - Foundations - General Plan, Piling Plan, Piers No. 1 and No. 6 |
| X-3 | Access Highway - Bridge - Superstructure - General Plan and Sections |

## SECTION I - INTRODUCTION

1-01. SCOPE. - This Analysis of Design covers the work done on bridges in connection with the St. Lawrence River Project, with the exception of those at the Navigation Canal Locks. The lock bridges are covered in the Analysis of Design of the locks.

1-02. STATUS OF DESIGN. - Detailed plans for all of the bridges described have not been prepared, but sufficient design for estimating purposes has been completed. Descriptions of the several designs considered and proposed are given in Sections V to X, inclusive.

1-03. FOUNDATION EXPLORATION. - An account of the explorations to determine the character of the foundation at each site investigated is given in Section V.

## SECTION II - DESIGN LOADS

2-01. HIGHWAY BRIDGES - LIVE LOADS. - Highway spans were designed for the standard H-20 live loading of the American Association of State Highway Officials, 1941 Specification.

2-02. COMBINED HIGHWAY AND RAILROAD BRIDGES - LIVE LOADS. - Bridges to carry railroads were designed for Cooper's engine and train loading in accordance with the 1940 Specifications of the American Railway Engineering Association, with class of loading as specified in Section VI to IX, inclusive. Where highway and railroad loadings occur on the same span, the H-20 highway loading is applied to that portion of the highway outside of the railroad clearance line simultaneously with the railroad loading.

2-03. DEAD LOADS. - All Structures are designed for full computed dead loads, in addition to live loads. Dead load camber is provided for as specified for each type of structure in applicable sections of the 1941 Specifications of the American Association of State Highway Officials and of the American Railway Engineering Association for highway and railroad spans, respectively.

2-04. ICE LOADS, WIND LOADS, STREAM CURRENT, AND DRIFT. - In estimating loads due to ice, wind, stream flow and drift, the recommendations of the 1941 Specifications of the American Association of State Highway Officials were followed. Ice thickness of 12 inches was assumed and, on round piers, the effective width of pier was taken as 2/3 of the diameter. The intensity of pressure used was 400 pounds per square inch.

## SECTION III - UNIT STRESSES

3-01. GENERAL. - Except as noted below, the working stresses used in the design are as recommended by the American Association of State highway spans, and by the American Railway Engineering Association for railway spans.

3-02. CONCRETE. - Working stresses for the two classes of concrete (see Section IV) are as follows:

| Nature of Stress | 3400 Lb. Concrete Class A lbs./sq.in. | 3000 lb. Concrete Class B lbs./sq.in. |
|---|---|---|
| 1. FLEXURE | | |
| a. Extreme fiber stress in compression | 1225 | 1050 |
| b. Extreme fiber stress in compression adjacent to supports of continuous or fixed beams or of rigid frames | 1400 | 1200 |
| c. Extreme fiber stress in tension - Plain concrete only | 70 | 60 |
| 2. AXIAL COMPRESSION | | |
| a. In short columns with lateral ties (banded columns) | 785 | 675 |
| b. In short columns with continuous spirals | 980 | 840 |
| c. Pedestals - Unreinforced - Gross section | 875 | 750 |
| d. Composite Columns | 875 | 750 |
| 3. BEARING | | |
| a. Load over entire area | 875 | 750 |
| b. Load over partial area - Maximum permissible | 1225 | 1050 |
| 4. COMBINED BENDING AND DIRECT STRESS - COMPRESSION IN EXTREME FIBER - In no case will the section be less than that required where axial load alone is considered using stresses in 2-a and 2-b above. | | |
| a. Spiral columns with entire section in compression | 1225 | 1050 |
| b. Spiral columns - Tension in section | 1225 | 1050 |
| c. Banded columns - Entire section in compression | 1050 | 900 |
| d. Banded columns - Tension in section (Short columns only, i.e. max. l/r=40) | 1225 | 1050 |
| e. Arches | 1225 | 1050 |

| Nature of Stress | 3400 lb. Concrete Class A lbs./sq.in. | 3000 lb. Concrete Class B lbs./sq.in. |
|---|---|---|
| 5. SHEAR | | |
| a. Beams - No web reinforcement nor special anchorage of longitudinal steel | 70 | 60 |
| b. Beams - No web reinforcement - longitudinal bars specially anchored | 105 | 90 |
| c. Beams - Web reinforcement but longitudinal bars not anchored | 210 | 180 |
| d. Beams - Web reinforcement and longitudinal bars specially anchored | 315 | 270 |
| e. Flat slab - At critical section | 105 | 90 |
| f. Footings with hooked ends | 105 | 90 |
| g. Punching shear | 260 | 225 |
| h. Flat slabs - Beams at walls and openings - Torsional shear plus direct shear - Web reinforcement and longitudinal bars specially anchored | 525 | 450 |
| 6. BOND | | |
| a. Beams, slabs, and oneway footings - Plain bars (where special anchorage is provided) | 140 | 120 |
| Deformed bars | 175 | 150 |
| b. Two-way footings | | |
| Plain bars | 105 | 90 |
| Deformed bars | 135 | 115 |
| c. Cold drawn steel wire | 70 | 60 |

## SECTION IV - CONCRETE

4-01. CLASSES. - Two classes of concrete will be used. In general, Class "A" concrete will be used in deck slabs, beams, sidewalks, etc; and Class "B" for reinforced abutments, piers, pile caps, and all other portions not designated for Class "A" concrete.

4-02. STRENGTH. - (28-day Compressive Strength)

| Class | Average for any 25 Consective Cylinders |
|---|---|
| A | 3400 lbs. per sq. in. |
| B | 3000 lbs. " " " |

4-03. CEMENT TYPE. - All cement will be of the moderate-heat-of-hardening type conforming to the requirements of Federal Specification SS-C-206a.

4-04. AGGREGATE INVESTIGATIONS. - Extensive surveys have been made of the sources of fine and coarse aggregates in the vicinity of the project. The results of these surveys are described in detail in paragraph 12-03 of the Analysis of Design for Long Sault Dam.

4-05. COARSE AGGREGATE.

(a) Quality. - Coarse aggregate of standard quality will be required and may be washed gravel or crushed stone. An allowance is made of 5 percent for soft fragments, 1/4 of 1 percent clay lumps, and removal by decantation of 1 percent.

(b) Sizes. - Coarse aggregate will be graded and stored separately in three sizes, namely:

(1) 3/16" to 3/4"
(2) 3/4" to 1-1/2"
(3) 1-1/2" to 3"

For Class "A" concrete the maximum size aggregate will be not more than 1-1/2 inch; and for Class "B" not more than 3 inches.

4-06. FINE AGGREGATE.

(a) Quality. - Fine aggregate will consist of either natural sand or crushed stone sand. If crushed stone sand is used, it will be made from durable dolomite or other stone of equal or greater resistance to leaching, abrasion and frost action.

(b) Size. - Fine aggregate will be well graded from coarse to fine and will be required to have slightly higher percentages of material passing the No. 50 and No. 100 sieves than are customarily required. The finer gradation is intended to aid in improving the workability and watertightness of the concrete.

(c) Tests. - Both fine and coarse aggregate will be subjected to careful, thorough analyses to determine conformity with all specified requirements, including freezing and thawing and magnesium sulphate tests for soundness.

4-07. MIXING WATER. - Results of standard laboratory tests and reports from the U. S. Geological Survey indicate that St. Lawrence River water is satisfactorily free from injurious chemicals and ordinarily free from excessive amounts of suspended silts, etc.

4-08. PROPORTIONING.

(a) Aggregate. - The total volume and proportions of aggregates to be used in each cubic yard of concrete will be that necessary to produce a dense mixture of the required workability. The individual mixes will be designed to secure concrete having suitable workability, density, impermeability, and required strength without the use of an excessive amount of cement.

(b) Cement. - It has been assumed that the two classes of concrete to be used would have the following cement contents per cubic yard:

| | |
|---|---|
| Class "A" | 5.0 to 6.0 bags |
| Class "B" | 4.0 to 5.0 bags |
| Concrete deposited in water | 6.5 bags |

(c) Water Content and Consistency of Concrete. - In calculating a total water content in any mix, the amount of moisture carried on the surfaces of the aggregate particles shall be included. In all cases, the amount of water to be used will be the minimum amount necessary to produce a plastic mixture of the strength specified and of the desired density, uniformity, and workability. In general, the consistency of any mix will be that required for the specific placing conditions and methods of placing. Ordinarily the slump shall be between 1-1/2 inch and 2 inch for Class "B" and between 1-1/2 inch and 3 inch for Class "A" by "Method of Testing for Consistency of Portland Cement Concrete" of the American Society for Testing Materials.

4-09. MIXING AND PLACING.

(a) Plant. - The contractor will be required to provide a complete, modern and dependable mixing plant equipped with automatic timers, weighing units and means for measuring and indicating water entering the mixes.

(b) Placing. - Thorough cleaning, dewatering, and preparation of rock surfaces will be required before concrete is placed. Concrete shall be placed in a manner which will avoid segregation of materials. The specifications will require that the maximum height of lift for any structure be approved by the contracting officer.

4-10. FINISHING. - Exposed concrete surfaces are to be given a smooth finish but rubbing with carborundum will not be required.

4-11. ABSORPTIVE FORM LINING. - Absorptive form lining of approved type will be required on all permanently exposed formed concrete surfaces in order to insure a dense concrete surface.

## SECTION V - INVESTIGATIONS OF OVERBURDEN AND BEDROCK

5-01. GENERAL. - In conjuction with economic studies made for the proposed highway and railroad bridges, all proposed sites were investigated to determine geological and subsurface conditions. The exploration conducted by the U. S. Corps of Engineers for the purpose of obtaining overburden and bedrock information included geological reconnaissance, drilling in overburden and bedrock, probing, excavation of test pits and auger holes, and the determination of bedrock elevations by the seismic method. Complete field logs of the drill holes, probings, test pits and auger holes, and the results of the seismic investigations are on file in the St. Lawrence River District Office. All soil samples and rock cores are stored in the district soils laboratory.

5-02. METHODS OF EXPLORATION. - Holes of two sizes were drilled while exploring the bridge sites. Holes for the purpose of determining both overburden and bedrock conditions were drilled with diamond core drilling equipment using 3-1/2 inch casing in the overburden and 2-1/8 inch bit to obtain rock cores. Holes drilled specifically for overburden investigation were drilled using 2-1/2 inch and 3-1/2 inch casings were used, the overburden was dry sampled using a sampling tube 1-1/2 inches and 2 inches in diameter, respectively. Soil samples were taken at 5-foot intervals or at changes in material, and wash boring between samples was permitted. Holes were probed with a Highmark Probing Machine using a 1-1/4 inch diameter probing pipe with a removable closed pointed end. The probing pipe was driven with a hammer weighing 164 pounds, dropping approximately 12 inches at an average rate of 50 blows per minute. Seismic lines were fired at one proposed bridge site, as shown on Plate V-6, to determine the elevation of bedrock and the existing soil conditions. The method used was developed by E. R. Shepard, Senior Physicist, Office of the Chief of Engineers. A report describing the entire seismic investigation conducted at the St. Lawrence River Project is on file at the District Office. Test pits and auger borings were excavated to determine overburden conditions at some sites. The location and records of all exploration are shown on Plates V-1 to V-6.

5-03. RESULTS OF EXPLORATION. - The overburden and bedrock conditions at each of the bridge sites are discussed in the following paragraphs.

(a) New York Central Railroad Relocation Bridges.

(1) Grass River Crossing. - Four holes, D-1305, D-1306, D-1311, were drilled in the river at this site at the locations shown on Plate V-1. As disclosed by the drill holes, bedrock varies between Elevation 101.2 on the southeast side of the river and 113.4 on the northwest side of the river. At D-1305 on the northwest side of the river the overburden consists of loose sand and silt to 11.0 feet underlain by loose to compact silty sand and gravel to bedrock which is at Elevation 113.4. At D-1306 on the southeast side of the river the overburden is composed of fairly loose, silty, sand and gravel to bedrock which is at Elevation 101.2. The overburden at holes D-1310 and D-1311 in the river channel consists of 18 to 28 feet of soft, silty clay overlying fairly loose, silty, sand and gravel. Bedrock at holes D-1310 and D-1311 was encountered at Elevations of 103.8 and 102.6, respectively.

(2) Polly's Gut Crossing. - Three holes, D-1372 to D-1374,

inclusive, were drilled at this site at the locations shown on Plate V-2. The bedrock is apparently quite level varying between Elevation 102.9 and 98.8 at the three drill holes. The overburden on both the Massena Point and Cornwall Island abutments and in the bed of Polly's Gut is fairly loose to compact, silty, gravelly sand.

(3) Bridge Site in the Vicinity of the Canadian Customs Office on Cornwall Island. - Two holes, D-1256 and D-1257, were drilled at the locations shown on Plate V-4. Drill holes D-1256 and D-1257 showed rock to be at Elevation 117.7 and 102.6, respectively. At D-1256 the overburden consisted of 8 feet of silty clay underlain by silty, gravelly sand, and at D-1257 the overburden consisted of 12.0 feet of soft sand and silt underlain by silty, gravelly sand.

(b) Barnhart Island Access Bridge. - Four holes were drilled at this site at the locations shown on Plate V-3. Hole D-1245 drilled on the New York mainland showed rock to be at Elevation 119.6 and the overburden at this location consisted of fairly compact to compact, silty, and gravelly sand. Holes D-1246 and D-1252 were drilled in the south channel and showed rock to be at Elevation 120.3 and 127.1, respectively. At D-1246 the overburden consisted of compact, silty, and gravelly sand while at D-1252 soft, silty clay exists to within a foot of bedrock. D-1253 drilled on Barnhart Island showed rock to be at Elevation 144.5. The overburden at the hole consisted of 16 feet of loose uniform sand overlying soft, silty clay which extends to a depth of 45 feet and is underlain by compact, silty, and gravelly sand to bedrock.

(c) Bridge at Lock 19. - No subsurface investigations have been made at this site. Four probings were made in the vicinity of Lock 19 in conjunction with the earth embankment for the railroad fill. The locations of the probings are shown on Plate V-4. The probings showed the overburden to be apparently firm but because the excavation from the Cornwall Canal may have been spoiled in this area, the results of these probings are not conclusive and soil conditions may be quite variable. This site should be explored with drill holes before final design of the bridge is completed.

(d) State Highway Bridges on Route 37.

(1) Bridge Site at Coles Creek. - Exploration consisting of one drill hole and five test pits has shown the overburden in the valley bottom at the Coles Creek site to consist of 0 to 5.0 feet of silty sand underlain by compact, silty and gravelly sand. The location and record of the exploration is shown on Plate V-5.

(2) Bridge Site at Brandy Brook. - Two test pits and two auger holes were excavated to esplore this site. The location and record of the exploration is shown on Plate V-5. The overburden in the valley bottom and abutments consists of firm material, generally a silty, gravelly sand.

(3) Bridge Site at Little Sucker Brook. - One test pit was excavated in the valley bottom at the Little Sucker Brook site at the location shown on Plate V-5. The pit showed silty sand and gravel to exist 3.0 feet below the ground surface, and it is believed that the valley bottom consists of firm material throughout.

(e) Grass River Highway Bridge.

(1) Line "A," Grass River. - Four probings were made in the river at this site at the locations shown on Plate V-6. Probings PH-4198 and PH-4199 met refusal at the river bottom. Probing PH-4200 and PH-4201 penetrated 2 feet and 4.1 feet, respectively, below the bed of the river. PH-4200 met refusal but PH-4201 had to be discontinued becaused the current of the river bent the probing pipe and made further driving

impossible. The penetration rates of these probings indicate that the overburden is compact, firm material. From all exploration available, it is believed that bedrock at the site is between Elevations 130 and 140.

(2) Line "B," Grass River. - Two holes were drilled on shore and seven probings were made in the river at this site at the locations shown on Plate V-6. Drill holes D-1267 on the north bank and D-1268 on the south bank of the river showed rock to be at Elevations 140.2 and 148.5, respectively. On the north side of the river the overburden consisted of 15 feet of variable marine clay underlain by a fairly loose, variable, silty and gravelly sand. On the south bank of the river the overburden consisted of loose to fairly compact, silty and gravelly sand. The probings all met refusal at the bottom of the river.

(3) Line "C," Grass River. - Four holes were probed in the river at this site at the locations shown on Plate V-6. All probings met refusal at the bottom of the river.

(4) Massena Power Canal Bridge Site. - Four seismic lines were fired to determine the elevation of bedrock at this site. The locations of the lines are shown on Plate V-6. The results indicate that the elevation of bedrock in the vicinity varies between 139.8 and 147.5 feet.

## SECTION VI - NEW YORK CENTRAL RAILROAD RELOCATION BRIDGES

6-01. GENERAL. - Relocation of the tracks of the New York Central Railroad, Ottawa Division, and of the Roosevelt Bridge Highway, necessitates construction of three permanent combined highway and railroad bridges according to the relocation plan adopted, which is shown on Plate VI-1. A complete explanation of the reasons for selecting this relocation plan appears in the "Design Analysis, New York Central Railroad - Ottawa Division and Roosevelt Bridge Highway Relocation" which appears as Appendix III-0(3) in the Final Report on the St. Lawrence River Project and in Chapter III, Feature 35, in the body of the Report.

The bridges described in this section are those over the Grass River and over Polly's Gut. The third bridge, which is not described in this Analysis, will be a swing bridge at the Grass River Lock of the navigation canal and is covered in the Analysis of Design for the Lock.

A Part of the relocation plan is the removal of the present highway and railway bridge across the south channel of the St. Lawrence River between the New York mainland and Cornwall Island.

6-02. PRIORITY. - Relocation of the railroad and highway will not be necessary if the St. Lawrence Development does not include the navigation canal. If the canal is built, the relocation work need not be completed until such time as the canal is ready for use. However, completion of a portion of the new route, including the Grass River Bridge, would be desirable as a means of access to the site of the Grass River Lock.

6-03. GRASS RIVER BRIDGE.

(a) Designs Considered. - Three designs, as tabulated below, were considered, each providing for a 20-foot highway with a single track railroad in the center of the highway. Timber decking will be used under the rails, with a concrete roadway slab on either side. Pier foundations will be on rock and the abutments will be supported by steel H-beam piles to rock. All three designs are for bridges at approximately the same location. Railroad live load is E-60.

(1) Four deck plate girder spans, each 133 feet 6 inches long with a 29 foot 6 inch approach span at each end and a removable 75 foot center span. Total length, 668 feet. Bridge on 30° skew. Deck Elevation 184.

(2) Three continuous 163 foot deck plate girder spans on each end with a 76 foot lift span at the center. Total length, 1054 feet. Deck Elevation 170.

(3) Three continuous 152 foot deck plate girder spans on each end with an 84 foot center span. Total length, 996 feet. Deck Elevation 211.

(b) Design Adopted. - Design Number 3 was adopted, although comparative estimates show its cost to be considerably more than design Number 1 and about the same as design Number 2. The advantage of design Number 3 is that it provides a clearance of 50 feet at low water, which is adequate for passage of the Aluminum Company dredge, thus eliminating the need for a lift or removable span. The deck will be well above the maximum high water level, Elevation 176.

## 6-04. BRIDGE OVER POLLY'S GUT.

(a) Designs Considered. - Four designs were considered for this bridge, as tabulated below, with deck arrangement and construction, piers, and abutments as described for the Grass River Bridge. All four designs are for bridges at approximately the same location. Railroad live load is E-60.

(1) Three continuous 166 foot deck plate girder spans at each end. Total length, 1000 feet. Deck Elevation 190.

(2) Three continuous 140 foot deck plate girder spans at each end. Total length, 840 feet. Deck Elevation 215.

(3) Truss cantilever. Center span 440 feet, each end span 200 feet. Total length, 840 feet. Deck Elevation 205.

(4) Continuous truss bridge. Center span 440 feet, each end span 200 feet. Total length, 840 feet. Deck Elevation 205.

(b) Design Adopted. - On the basis of economy, as indicated by comparative estimates, design Number 2 was adopted.

## SECTION VII - BARNHART ISLAND ACCESS BRIDGE

7-01. GENERAL. - Studies have been made for a temporary bridge to span the south channel between the mainland and Barnhart Island. The purpose of this bridge would be to provide access to the powerhouse site for transportation of construction equipment, and the bridge would be removed after completion of the project. However, the period of usefulness would be short on account of the time required for construction, and it is doubtful whether construction of this bridge is warranted.

7-02. DESIGN LOADING. - The E-40 railroad loading with modified impact for reduced speeds was used. The highway is designed for the standard H-20 loading of the A.A.S.H.O.

7-03. DESIGN. - Studies made include deck plate girder bridges, both simple span and continuous, truss cantilever and suspension types. All studies provide for a single track railroad on one side decked over for heavy equipment and for a highway with a three-foot sidewalk on the other side. Comparative estimates were not made and no selection for a final design was made from the studies. Types and locations considered are shown on Plate VII-1.

## SECTION VIII - ACCESS BRIDGE AT LOCK 19 - CORNWALL CANAL

8-01. GENERAL. - The purpose of this bridge is to provide access by highway and railroad from the Canadian side of the St. Lawrence River across the Cornwall Canal to the Barnhart Island Powerhouse, both during construction and after completion of the project. The south abutment must rest on the narrow canal embankment and the highway and railroad must bear sharply to the west from the south end of the bridge to follow the embankment to the end of the powerhouse. In order to keep the curve radii as large as practicable, the bridge crosses the canal on a 48° angle with the lock center line. The location plan is shown on Plate VIII-1.

8-02. PRIORITY. - This bridge should be completed as soon as possible after the start of construction on the St. Lawrence project, as it will be needed at an early stage for transporting materials and equipment to the powerhouse construction area.

8-03. DESIGN.

(a) Location and Alignment. - There was little choice in location as the crossing at the lock shows obvious economy over the longer crossing which would be required elsewhere on the canal. An earlier plan for a crossing about one mile upstream from the lock was abandoned, as studies indicated that a construction bridge across the canal between locks would cause considerable delay to shipping. The alignment was dictated largely by the conditions at the south approach as explained in paragraph 8-01.

(b) Span Arrangement. - The span arrangement adopted consists of a fixed steel truss span across the pool above the lock spillway on the north side of the canal, and a bob tail, concrete counterweighted, steel swing bridge on the south side across the lock near the upper gate. A short embankment section across an abandoned lock between the spillway and the present chamber connects the two spans. Both spans are of the Warren sub-divided through type. All piers are independent of the lock walls and rest on concrete piles. When retracted, the swing span will have a clearance of five feet from the edge of the lock wall with a maximum swing of approximately 50°. It is intended to use machinery identical with that to be used on the lock bridges at Grass River, Point Rockway and Robinson Bay, thus effecting a saving due to part duplication.

(c) Deck. - The deck on each span carries a 20-foot roadway, with a 3-foot sidewalk on each side, and a single track railroad in the center. The rails are of the girder type and rest on creosoted timber ties supported on the floor stringers. The roadway, including the area between the rails, is floored with open type grating in order to reduce dead load and to eliminate, as much as possible, accumulation of snow and ice.

(d) Loading. - The E-60 railroad loading with 25 percent impact was adopted.

## SECTION IX - STATE HIGHWAY NUMBER 37 - RELOCATION BRIDGES

9-01. GENERAL. - Flooding of lands along the south shore of the river, due to backwater from the Long Sault Dam, will make it necessary to relocate the portion of New York State Highway Number 37 from a point about 4000 feet east of Coles Creek, westward to Waddington Village. A discussion of the various locations considered and the reason for selecting the location adopted appear in the design Analysis for "Highway Relocation in the United States between Waddington and Massena, State Highway Routes 37 and 37-B," Appendix III-O(4) of the Final Report on the St. Lawrence River Project. A plan of these locations is shown on Plate IX-1.

A factor in the selection of Location 1 was the elimination of the necessity for a new bridge at Big Sucker Brook. Estimates were based on the construction of new bridges at Coles Creek, Brandy Brook and Little Sucker Brook. However, preliminary studies indicate that the present plate girder spans at these sites may possibly be utilized, thus further reducing costs.

9-02. PRIORITY. - The road relocation and bridges should be given a second priority as the old route may be used until the Long Sault Dam pool is formed.

9-03. DESIGN.

(a) General. - It is intended to build all three bridges in the dry and to excavate new channels afterward. Piers and abutments will be founded on piles. In each case, there will be three continuous, concrete beam and slab deck spans carrying a 22-foot roadway and a 5-foot sidewalk.

(b) Coles Creek Bridge. - Span lengths will be 40 feet, 30 feet and 40 feet.

(c) Brandy Brook Bridge. - Span lengths will be 42 feet, 30 feet and 42 feet.

(d) Little Sucker Brook Bridge. - Span lengths will be 34 feet, 30 feet and 34 feet.

## SECTION X - GRASS RIVER TEMPORARY HIGHWAY BRIDGE

10-01. GENERAL. - The Grass River highway bridge will be a temporary structure for access from the south side of the Grass River to Seaway Village, the Long Sault Dam and Canal, and the Powerhouse construction areas. Use of the existing Main Street bridge in Massena is not practicable on account of the large amount of traffic which it now carries and its location in a congested area with indirect approach routes at either end. The floor system of the present cantilever bridge at the Aluminum Company plant is inadequate in roadway width and load capacity for passage of heavy construction equipment, but studies have been made for increasing its capacity from its present 10 ton rating to H-20 highway loading. If this is done, the proposed bridge will not be built.

10-02. PRIORITY. - The bridge must be of first priority in order to have direct access to the construction areas as soon as possible after work is started on the St. Lawrence project.

10-03. DESIGNS CONSIDERED.

(a) The first design was for a 20° skew, steel stringer trestle carrying a highway only. It was originally intended to use H-beam pile bents but, due to the high rock elevation in the river bed, the design was changed to cellular type concrete piers and the skew was changed to 22°. The nine spans, totalling 513 feet 8 inches, consist of a removable center span of about 67 feet with three equal continuous spans on either end. The deck carries a 24-foot roadway and a 3-foot sidewalk. At the time this design was made, it was intended that a separate railroad crossing would be built by the Government about a mile downstream.

(b) The second design was for a combined highway and single track railroad bridge, eliminating a second crossing for a railroad. The total length is 584 feet. The highway portion consists of a 72-foot removable span in the center with three equal continuous spans and a 27-foot approach span at either end. In the railroad portion, six equal simple spans are used instead of the six continuous spans. The railroad deck is the open type and for E-50 loading. The highway deck consists of a 24-foot roadway and a 3-foot sidewalk, of concrete slabs over the fixed spans and concrete filled grating on the removable span.

(c) The third design was for an untreated timber Howe truss of the through type. This design was made for a highway crossing only, the Aluminum Company of America having proposed building a new railroad bridge across the power canal north of the existing Massena Terminal Railroad bridge. (See Plate V-6)

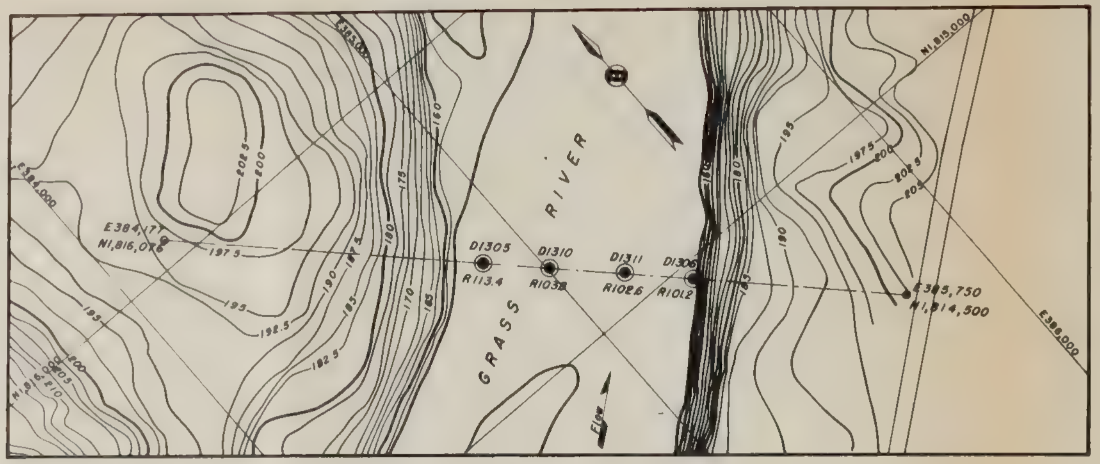
The bridge is on a 28° skew and connects New York State Highway 37 on the south side of the river with the County Highway on the north side. Ice conditions make it desirable to use a minimum number of piers in the river. The arrangement adopted is for seven spans arranged symmetrically about a 79-foot removable center truss span. At each end is a 20 foot 6 inch stringer approach span and two equal truss spans. The total length is 605 feet. It is intended that the center span will be removed on a barge or lifted up by derricks to give sufficient clearance for passage of the Aluminum Company dredge. The deck carries a 22-foot roadway and a 3-foot sidewalk. The highway deck is timber planking laid diagonally over laminated sub-flooring.

The two end bents and the two shore piers are on timber piles designed for 15 tons capacity. The four river piers are concrete to rock with a maximum computed foundation pressure of 11,400 pounds per square foot. It is expected that the lower portion of each river pier will be built in rock-filled cribs and the concrete in the shafts poured partly under water.

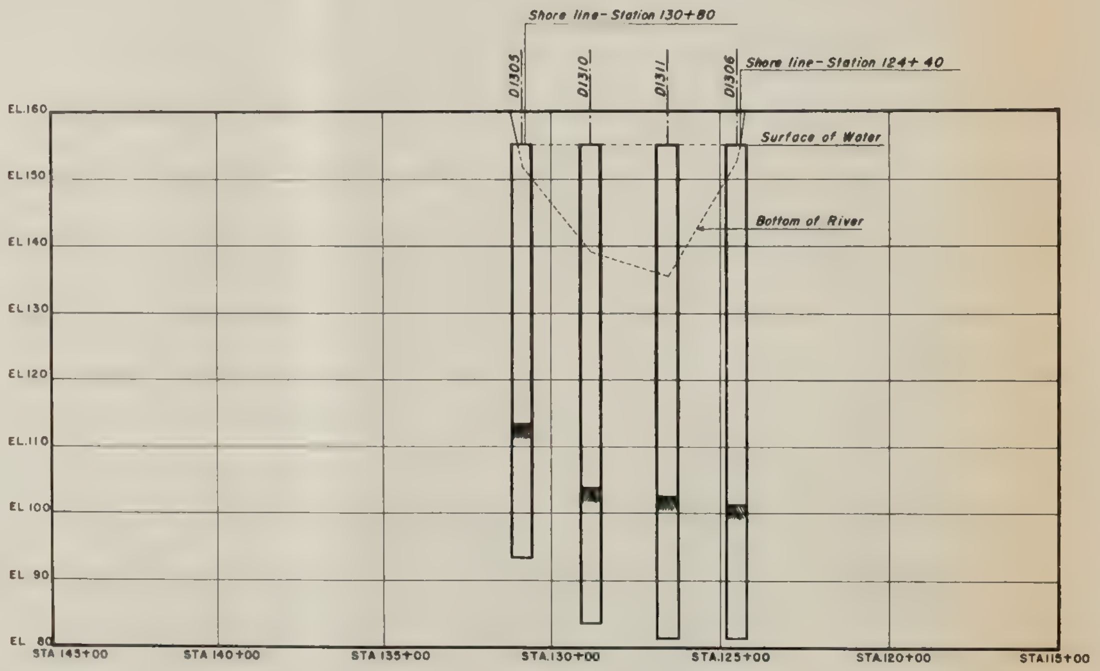
10-04. DESIGN ADOPTED. - The design described in 10-03(c) was adopted on the assumption that, if the existing Aluminum Company highway bridge is not strengthened and used for the access road to the construction areas, a separate railroad crossing will be used and this bridge will be needed for a highway crossing only. Plate X-1 shows the location plan, Plate X-2 the foundation plan, and Plate X-3 the superstructure arrangement.

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



PLAN



PROFILE

## D1305

| | | |
|---|---|---|
| 0.0 | EL. 155.2 | |
| | | WATER |
| 3.4 | EL 151.8 | |
| 5.5 | EL 149.7 | Top of Overburden |
| | | Soft mud. |
| 11.0 | EL. 144.2 | Loose dark brown SAND & SILT. |
| | | Loose grey slightly gravelly slightly clayey silty SAND |
| 25.4 | EL 129.8 | |
| 28.0 | EL 127.2 | Loose greyish brown slightly silty SAND. |
| 33.0 | EL 122.2 | Fairly compact grey slightly clayey SILT & SAND |
| | | Fairly compact grey slightly gravelly silty SAND Occasional boulders. |
| 41.8 | EL 113.4 | |
| | | DOLOMITE medium to light grey hard fine grained shaly. Considerable pyrite throughout Few stringers and thin beds of shale. Occasional weathered partings and seams. Rock slightly weathered and moderately broken |
| 62.0 | EL. 93.2 | |
| | | Core recovery 75.0% |

## D1306

| | | |
|---|---|---|
| 0.0 | EL. 155.2 | |
| | | WATER |
| 2.5 | EL. 152.7 | |
| | | Top of Overburden |
| 8.5 | EL. 146.7 | Apparently SAND & GRAVEL Numerous boulders. |
| | | Loose, grey, slightly gravelly, slightly clayey, |
| 18.4 | EL. 136.8 | SAND & SILT. |
| | | Fairly loose, grey, slightly clayey, SAND & SILT. |
| 23.0 | EL. 132.2 | Occasional boulders. |
| | | Fairly loose, grey, slightly clayey, slightly gravelly, silty SAND. |
| | | Fairly loose, grey, slightly gravelly SAND & SILT. |
| | | Loose, grey, slightly gravelly, silty SAND. |
| 36.4 | EL. 118.8 | Occasional boulders. |
| 39.0 | EL. 116.2 | Fairly soft grey slightly sandy SILT & CLAY Occasional boulders. |
| 45.0 | EL. 110.2 | |
| 46.2 | EL 109.0 | Fairly loose grey slightly clayey slightly gravelly silty SAND. |
| 54.0 | EL 101.2 | DOLOMITE dark grey hard shaly Considerable GYPSUM in stringers and crystals throughout Numerous stringers and occasional beds of shale. Few weathered seams throughout Rock moderately broken. |
| | | Core recovery 90.5% |
| 74.0 | EL. 81.2 | |

## D1310

| | | |
|---|---|---|
| 0.0 | EL. 155.3 | |
| | | WATER |
| 16.0 | EL 139.3 | Top of Overburden |
| | | Soft dark grey variable SILT & CLAY |
| 34.6 | EL 120.7 | Fairly loose grey slightly gravelly slightly clayey silty SAND. |
| 40.8 | EL 114.5 | |
| | | Loose to fairly compact grey slightly clayey SAND & SILT Few pebbles |
| 51.5 | EL. 103.8 | |
| | | DOLOMITE medium to dark grey hard. Few beds and stringers of shale. 3" zone of GYPSUM at 67.4'. Rock moderately broken, unweathered. |
| 71.5 | EL. 83.8 | |
| | | Core recovery 78.5% |

## D1311

| | | |
|---|---|---|
| 0.0 | EL 155.2 | |
| | | WATER |
| 19.5 | EL 135.7 | Top of Overburden |
| 22.0 | EL. 133.2 | Apparently soft mud |
| 25.2 | EL 130.0 | Loose grey slightly clayey slightly sandy SILT. |
| | | Soft grey slightly silty CLAY. |
| | | Loose grey slightly clayey slightly gravelly silty SAND. |
| 48.0 | EL. 107.2 | DOLOMITE medium grey fine grained. Occasional thin beds and stringers of shale. Numerous stringers of GYPSUM from 59' to 60'. Rock slightly weathered and moderately broken. |
| 53.6 | EL. 102.6 | |
| 60.4 | EL 94.8 | |
| 62.0 | EL. 93.2 | SHALE medium hard moderately broken. |
| | | DOLOMITE hard occasional stringers of shale. Considerable GYPSUM throughout. Trace of pyrite. Rock slightly weathered and moderately broken. |
| 74.0 | EL. 74.0 | |
| | | Core recovery 93.0% |

### DESCRIPTIVE TERMS:

Slightly silty etc. denotes approximately 1% to 20% by dry weight of silt etc

Silty etc. denotes approximately 20% to 40% by dry weight of silt etc.

SILT & SAND etc. denotes approximately 40% to 60% by dry weight of silt except "and clay" denotes more than 30% by weight of clay.

### NOTES.

Elevations are based on U. S. G. S. datum.

Analyses of overburden are based on dry samples.

Analyses of rock are based on 2 1/8" cores obtained by drilling.

Topography traced from ROSS SURVEY.

Shore line of river does not conform to present shore line.

### LEGEND:

◉ Denotes Drill Holes.

R - Denotes rock elevation.

| TRANSVERSE MERCATOR COORDINATES | | |
|---|---|---|
| HOLE NO. | EAST | NORTH |
| D1305 | 384,869 | 1,815,395 |
| D1306 | 385,306 | 1,814,951 |
| D1310 | 385,006 | 1,815,255 |
| D1311 | 385,165 | 1,815,094 |

ST. LAWRENCE RIVER PROJECT
NEW YORK CENTRAL
RAILROAD RELOCATION BRIDGE NO. 1
CROSSING GRASS RIVER

IN SHEETS SHEET NO SCALE 1" = 200' HOR. 1" = 10' VER.

200 0 200 400

U. S. ENGINEER OFFICE, MASSENA, NEW YORK FEB. 1942

SUBMITTED ENGINEER

RECOMMENDED HEAD ENGR LT. COL. CORPS OF ENGINEERS

APPROVED COL. CORPS OF ENGINEERS DISTRICT ENGINEER

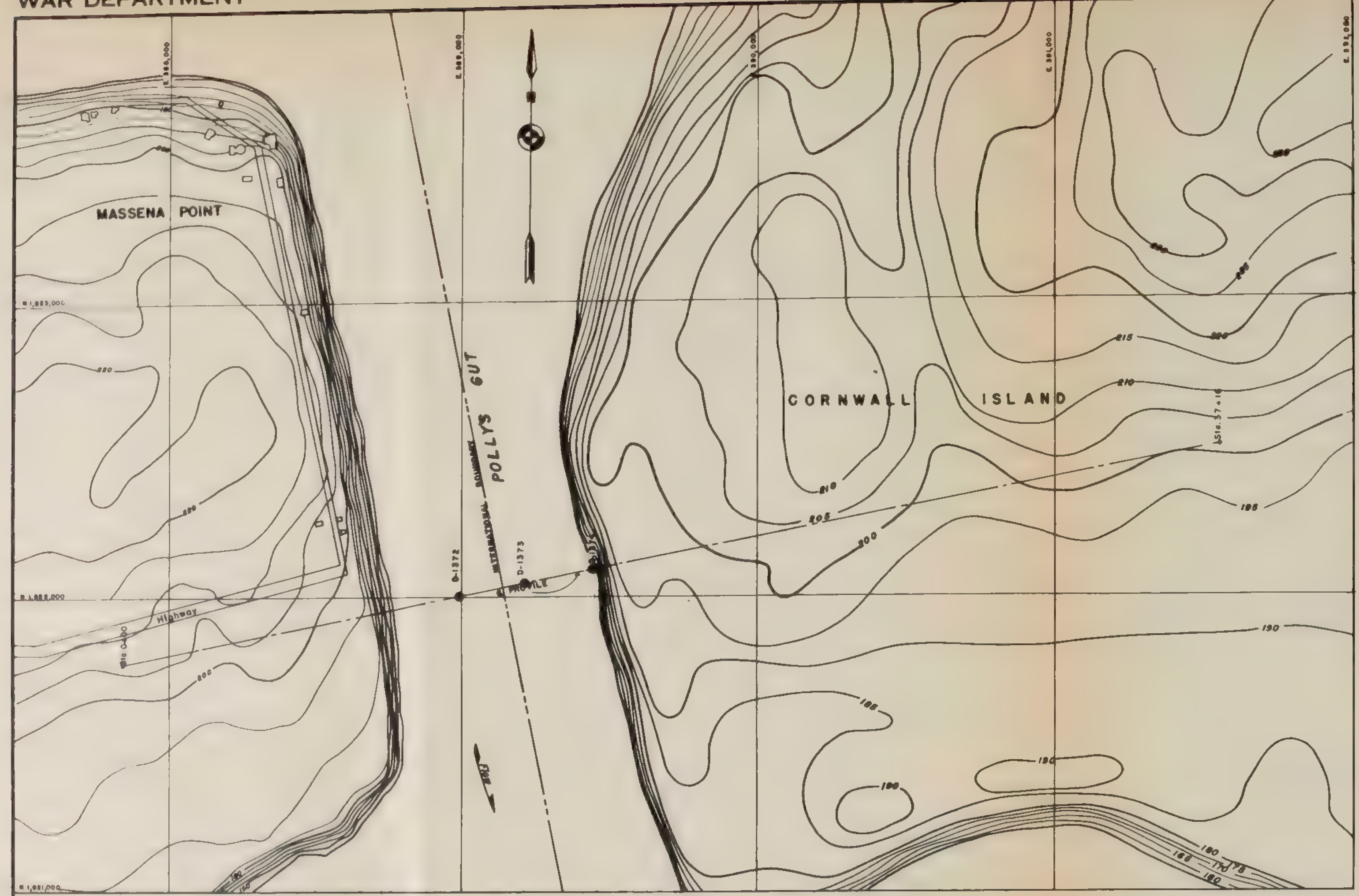
DRAWN BY R E B
CHECKED BY G. R. D

CMRR-1-2/1
FILE NO

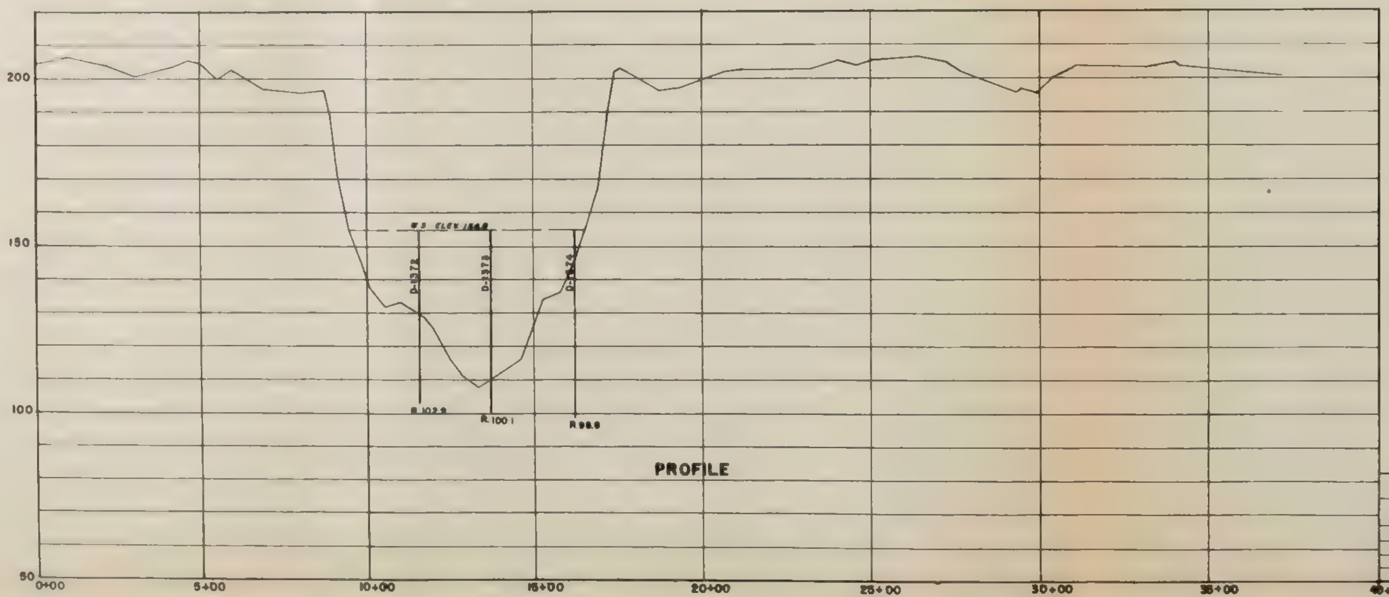
TRANSMITTED WITH LETTER OR ENDORSEMENT
DATED 194

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



PLAN



PROFILE

**D-1372**

| Depth | El. | |
|---|---|---|
| 0.0 | El. 154.8 | Water |
| 27.6 | 127.2 | Very compact, grey, slightly gravelly, slightly clayey, silty, SAND. |
| 33.4 | 121.4 | Fairly loose, grey, slightly gravelly, slightly clayey, silty, SAND. |
| 44.9 | 109.9 | Very compact, grey, slightly clayey, slightly gravelly, silty, SAND. |
| 51.9 | 102.9 | Top of rock. Dolomite, med. grey, hard. Occasional stringers of calcite. Considerable solution and weathering throughout. Rock broken along numerous joints. |
| 65.5 | 89.3 | SHALE, black, med hard. Rock badly broken and weathered. |
| 69.0 | 85.8 | DOLOMITE, dk. grey, hard. Occasional stringers of shale. Rock broken along few joints. Rock unweathered. |
| 71.9 | 82.9 | Core recovery 75% |

**D-1373**

| Depth | El. | |
|---|---|---|
| 0.0 | El. 154.8 | Water |
| 42.0 | 112.8 | Very compact, grey, slightly clayey, slightly gravelly, silty SAND. |
| 54.7 | 100.1 | Top of rock. DOLOMITE, dk grey, hard. Occasional stringers of shale and calcite. Rock badly broken and weathered along numerous joints. Considerable solution throughout. |
| 74.7 | 80.1 | Core recovery 86.1% |

**D-1374**

| Depth | El. | |
|---|---|---|
| 0.0 | El. 154.8 | Water |
| 4.5 | 150.3 | Fairly loose to fairly compact, grey, slightly clayey, slightly gravelly, silty, SAND. Occasional boulders. |
| 32.0 | 122.8 | Fairly loose to compact, grey, slightly clayey, slightly gravelly, silty, SAND. Occasional boulders. |
| 56.0 | 98.8 | DOLOMITE, dk grey, hard. Occasional bed of shale. Rock broken along occasional weathered joints. Badly dissolved and weathered zone. |
| 76.0 | 78.8 | Core recovery 90% |

RECORD OF EXPLORATION

DESCRIPTIVE TERMS

*Slightly silty etc. denotes approximately 1% to 20% by dry weight of silt etc.*

*Silty etc denotes approximately 20% to 40% by dry weight of silt etc.*

*Silt and sand etc. denotes approximately 40% to 60% by weight of silt etc. except "and clay" denotes more than 30% by weight of clay.*

LEGEND

● ...Drill Holes

**NOTE:**

*Elevations are based on Mean Sea Level.*
*Analyses of overburden based on drive sample*
*Analyses of rock based on cores obtained by drilling*
*Profile obtained by 1941 survey*

TRANSVERSE MERCATOR COORDINATES

| HOLE NO | NORTH | EAST |
|---|---|---|
| D1372 | 1,821,999 | 388,997 |
| D1373 | 1,822,046 | 389,213 |
| D1374 | 1,822,091 | 389,460 |

ST. LAWRENCE RIVER PROJECT
NEW YORK CENTRAL
RAILROAD RELOCATION BRIDGE NO. 3
CROSSING POLLY'S GUT

IN SHEETS SHEET NO. SCALE
200 0 200 400

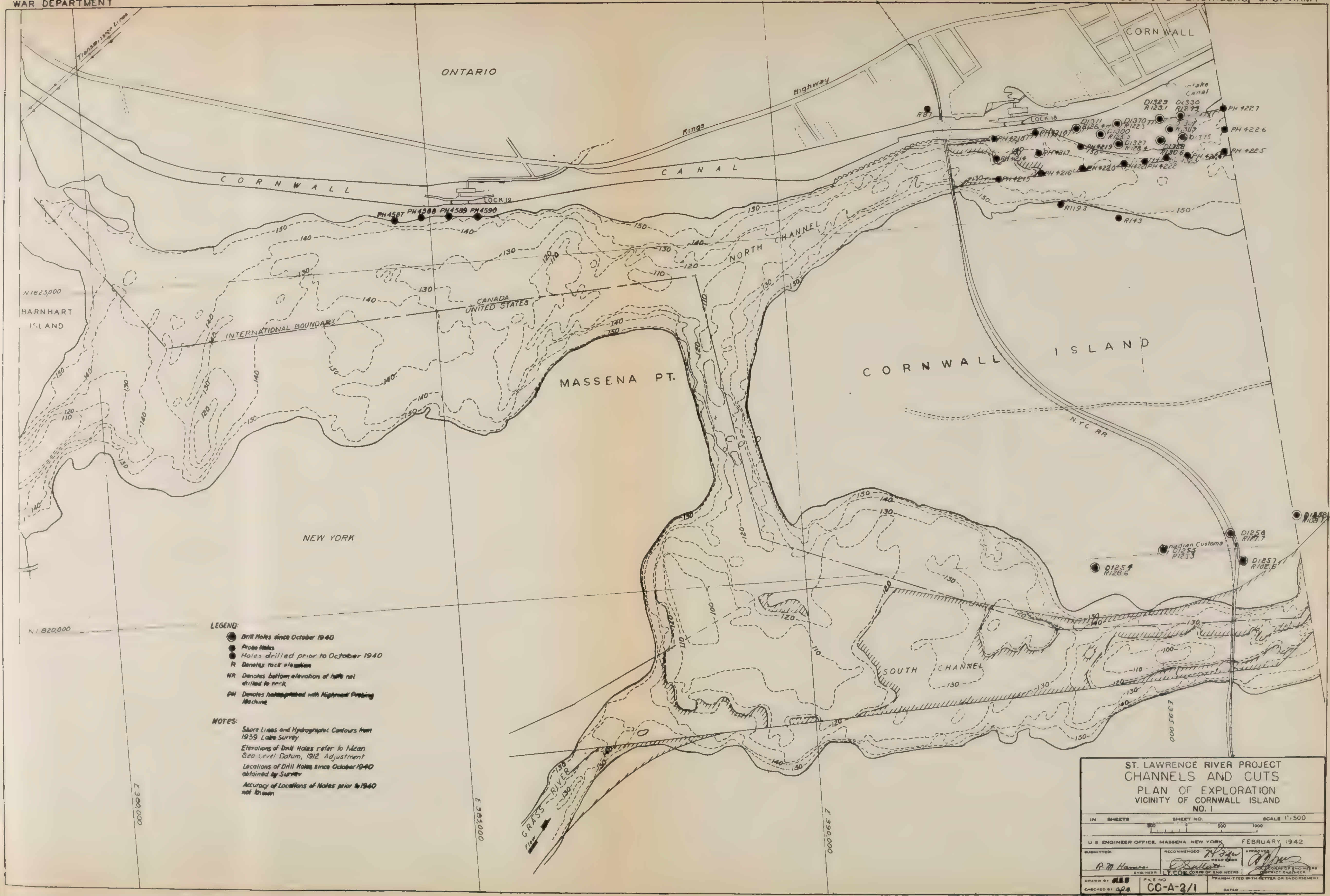
U. S. ENGINEER OFFICE, MASSENA, NEW YORK FEB 1942

SUBMITTED: ENGINEER
RECOMMENDED: LT. COL. CORPS OF ENGINEERS
APPROVED: COL. CORPS OF ENGINEERS DISTRICT ENGINEER

DRAWN BY: J.P.
CHECKED BY: G.R.B.
CMRR-1-2/2
FILE NO
TRANSMITTED WITH LETTER OR ENDORSEMENT
DATED 194

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



LEGEND:

- ◉ Drill Holes since October 1940
- ● Probe Holes
- ● Holes drilled prior to October 1940
- R Denotes rock elevation
- NR Denotes bottom elevation of hole not drilled to rock
- PH Denotes holes probed with Highmark Probing Machine

NOTES:

Shore Lines and Hydrographic Contours from 1939 Lake Survey

Elevations of Drill Holes refer to Mean Sea Level Datum, 1912 Adjustment

Locations of Drill Holes since October 1940 obtained by Survey

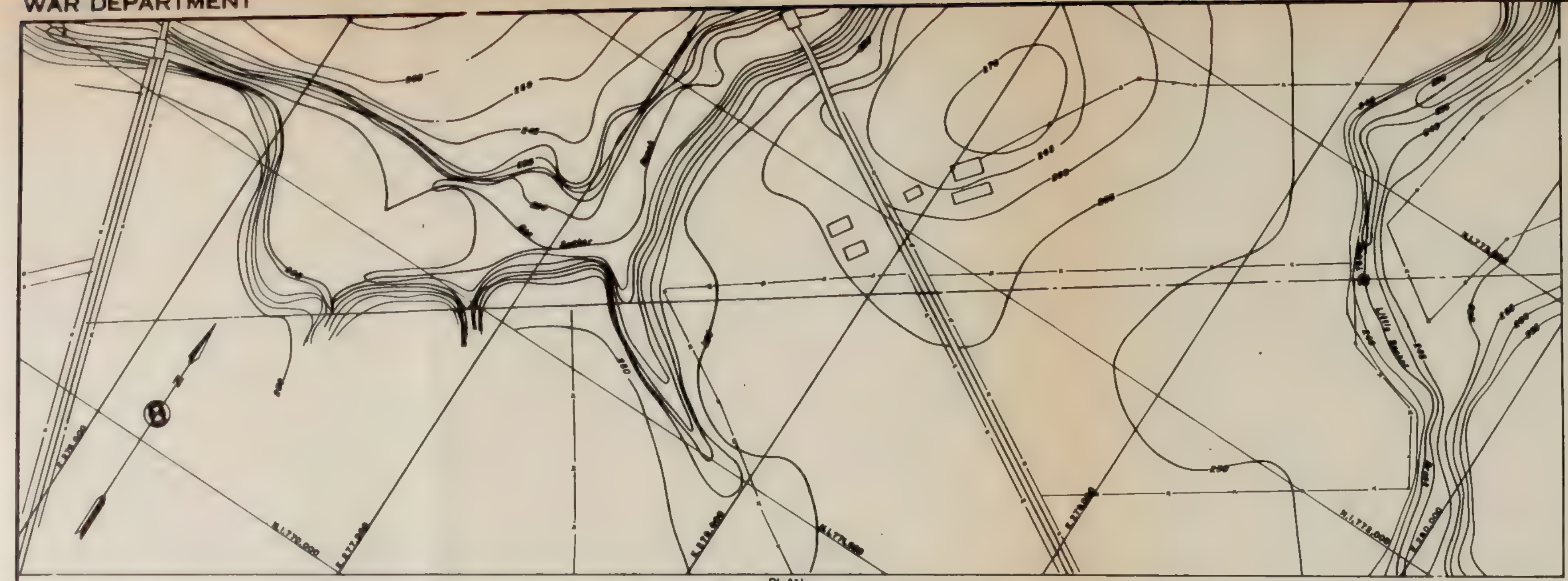
Accuracy of Locations of Holes prior to 1940 not known

ST. LAWRENCE RIVER PROJECT
CHANNELS AND CUTS
PLAN OF EXPLORATION
VICINITY OF CORNWALL ISLAND
NO. 1

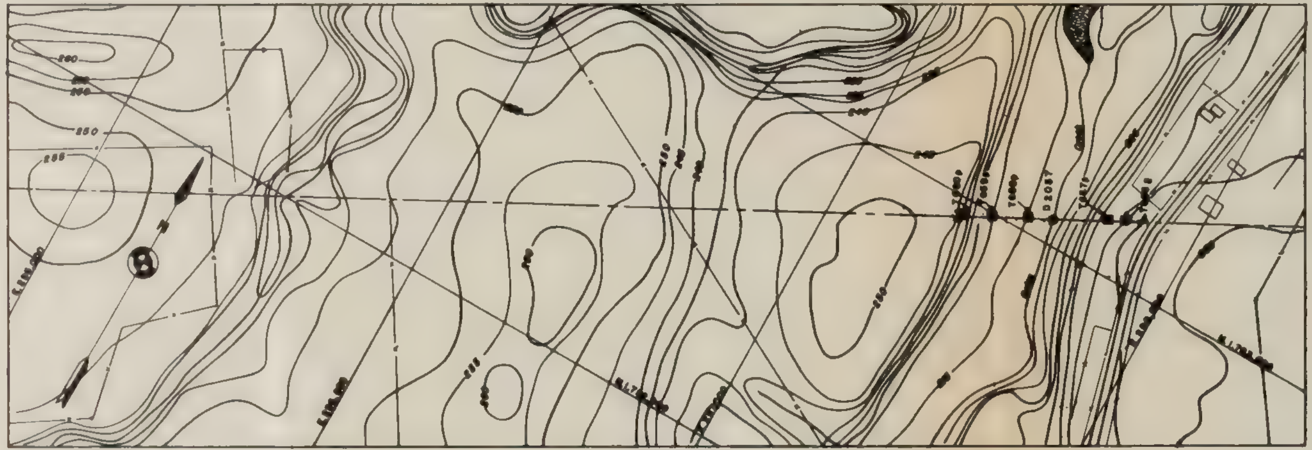
| | | |
|---|---|---|
| IN SHEETS | SHEET NO. | SCALE 1"=500 |
| 500 0 500 1000 | | |
| U S ENGINEER OFFICE, MASSENA, NEW YORK | | FEBRUARY, 1942 |
| SUBMITTED: R. M. Hanson<br>ENGINEER | RECOMMENDED: HEAD ENGR.<br>LT. COL. CORPS OF ENGINEERS | APPROVED:<br>COL. CORPS OF ENGINEERS<br>DISTRICT ENGINEER |
| DRAWN BY<br>CHECKED BY | FILE NO. CC-A-2/1 | TRANSMITTED WITH LETTER OR ENDORSEMENT<br>DATED |

WAR DEPARTMENT

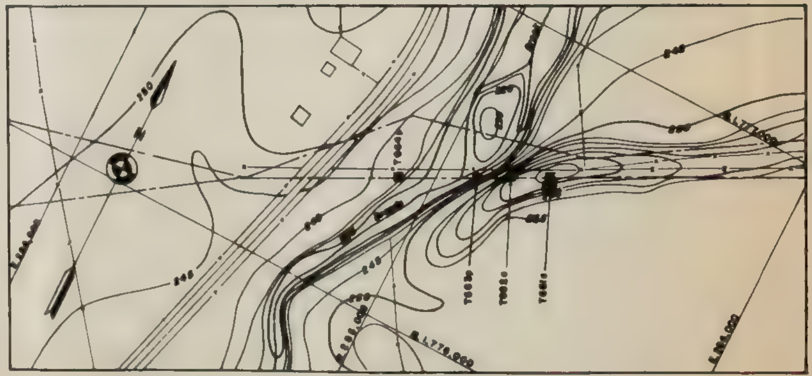
CORPS OF ENGINEERS, U. S. ARMY



PLAN
VICINITY OF BIG SUCKER AND LITTLE SUCKER BROOKS

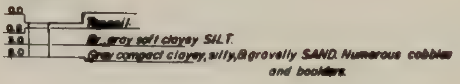


PLAN
VICINITY OF COLES CREEK

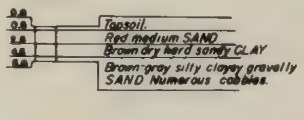


PLAN
VICINITY OF BRANDY BROOK

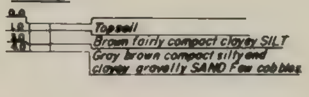
**T665p**


0.0
Topsoil.
Br. gray soft clayey SILT.
Gray compact clayey, silty, & gravelly SAND. Numerous cobbles and boulders.

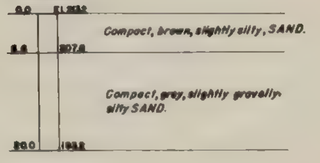
**T656p**


0.0
Topsoil.
Red medium SAND
Brown dry hard sandy CLAY
Brown-gray silty clayey gravelly SAND Numerous cobbles.

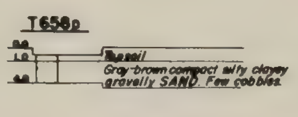
**T657p**


0.0
1.0
Topsoil
Brown fairly compact clayey SILT
Gray brown compact silty and clayey gravelly SAND Few cobbles

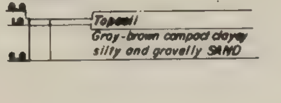
**D2057**


0.0
Compact, brown, slightly silty, SAND.
Compact, gray, slightly gravelly silty SAND.

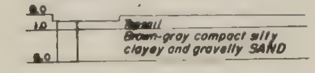
**T658p**



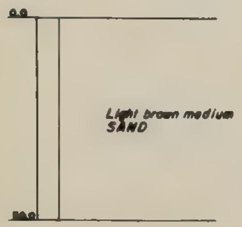
**T659p**



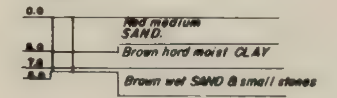
**T660p**



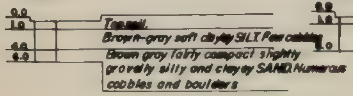
**T661a**



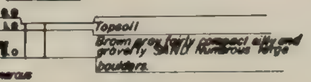
**T662a**



**T663p**


0.0
1.0
Topsoil.
Brown-gray soft clayey SILT Few cobbles
Brown gray fairly compact slightly gravelly silty and clayey SAND. Numerous cobbles and boulders

**T664p**


0.0
Topsoil
Brown gray fairly compact silty and gravelly SAND Numerous large boulders.

LEGEND

■ T...p Denotes Test Pit
■ T...a Denotes Auger Hole
● D... Denotes Drill Hole

| TRANSVERSE MERCATOR COORDINATES | | |
|---|---|---|
| NO. | NORTH | EAST |
| T661a | 1,776,610 | 285,300 |
| T662a | 1,776,560 | 285,195 |
| T663p | 1,776,520 | 285,110 |
| T664p | 1,776,405 | 284,886 |
| T665p | 1,772,705 | 279,365 |
| T656p | 1,783,182 | 297,787 |
| T657p | 1,783,158 | 297,745 |
| T658p | 1,783,030 | 297,630 |
| T659p | 1,782,976 | 297,457 |
| T660p | 1,782,930 | 297,383 |
| D2057 | 1,783,074 | 297,598 |

DESCRIPTIVE TERMS

*Slightly silty etc. denotes approximately 1% to 20% by dry weight of silt etc.*

*Silty etc. denotes approximately 20% to 40% by dry weight of silt etc*

*Silt and sand etc denotes approximately 40% to 60% by dry weight of silt etc. except "and clay" denotes more than 30% by dry weight of clay*

*Note*
*Maps based on 1941 survey*
*Coordinates of D2057 and T656 to 660 incl are exact*
*Coordinates of T661 to T665 incl are approx*
*Analyses of overburden based on dry samples*
*Elevations based on U.S.G.S. datum M.S.L. 1912 adjustment.*

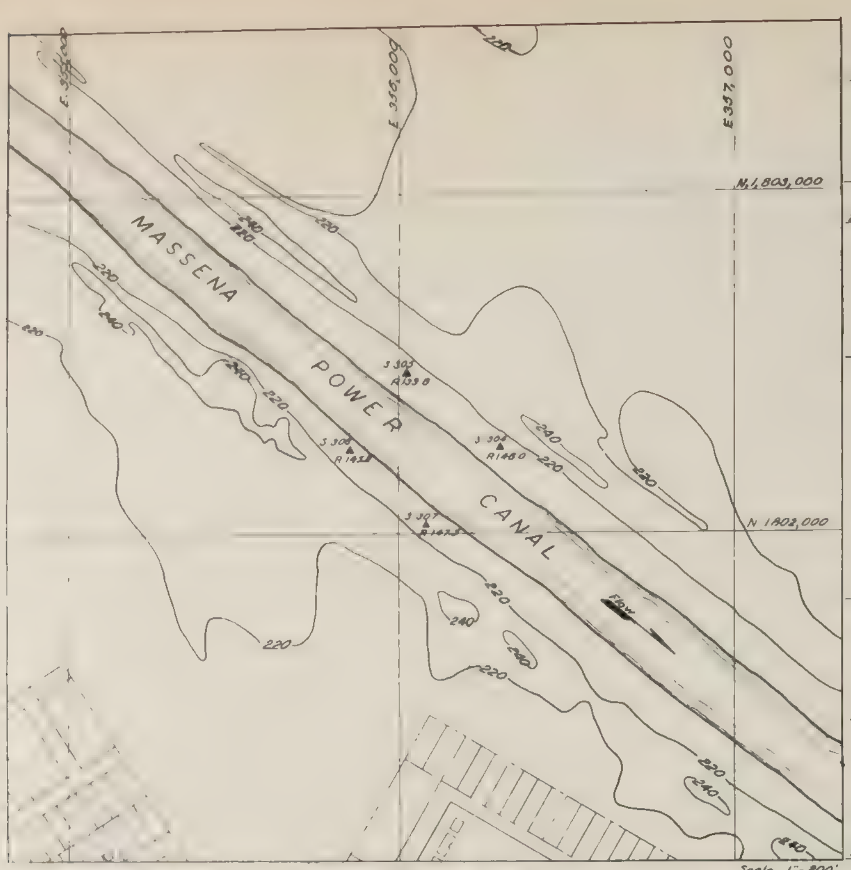
ST. LAWRENCE RIVER PROJECT
HIGHWAY RELOCATION
PLAN AND RECORD OF EXPLORATION
BRIDGE SITES VICINITY OF WADDINGTON

IN SHEETS SHEET NO SCALE 1" = 200'
200' 0 200' 400

U. S. ENGINEER OFFICE, MASSENA, NEW YORK FEB 1942

SUBMITTED: R. M. Haynes ENGINEER
RECOMMENDED D. Sullam LT. COL. CORPS OF ENGINEERS
HEAD ENGR
APPROVED: COL. CORPS OF ENGINEERS DISTRICT ENGINEER

DRAWN BY: J P
CHECKED BY:
WHN-1-2/1
FILE NO
TRANSMITTED WITH LETTER OR ENDORSEMENT
DATED 194



MASSENA POWER CANAL
BRIDGE SITE

D1267

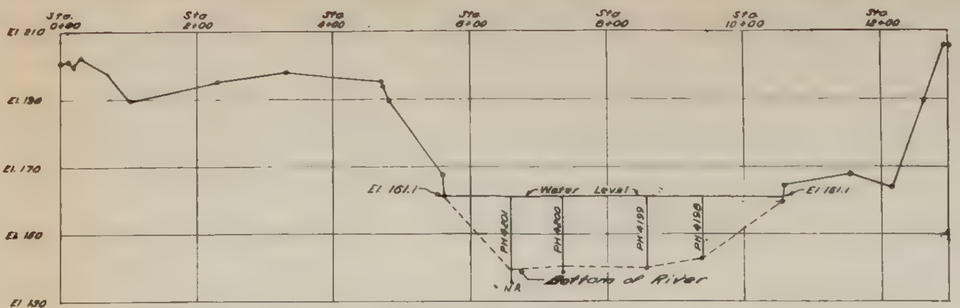
| Depth | Elev. | |
|---|---|---|
| 0.0 | 161.3 | Fairly compact to soft grey, slightly silty, slightly sandy CLAY. |
| 15.0 | 146.3 | Fairly loose grey slightly silty, slightly gravelly SAND. |
| 21.1 | 140.2 | **DOLOMITE** hard few stringers of calcite and shale<br>Few small solution zones and slightly weathered seams<br>Possible open cavity and traces of GYPSUM at 39.0<br>Rock broken and slightly weathered |
| 41.1 | 120.2 | |

Core Recovery 90%

D1268

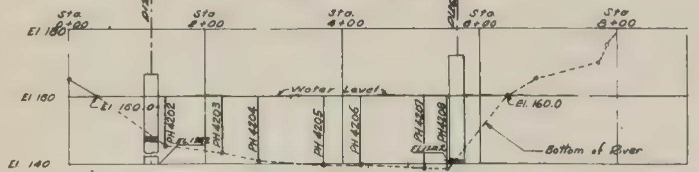
| Depth | Elev. | |
|---|---|---|
| 0.0 | 166.5 | Loose to fairly compact, brown, slightly silty, slightly gravelly SAND. |
| 17.9 | 148.6 | DOLOMITE, hard, broken along occasional [illegible] and [illegible] joints considerable solution on few small seams.<br>Rock [illegible] broken and slightly weathered |
| 38.[illegible] | 12[illegible] | |

Core Recovery 92%



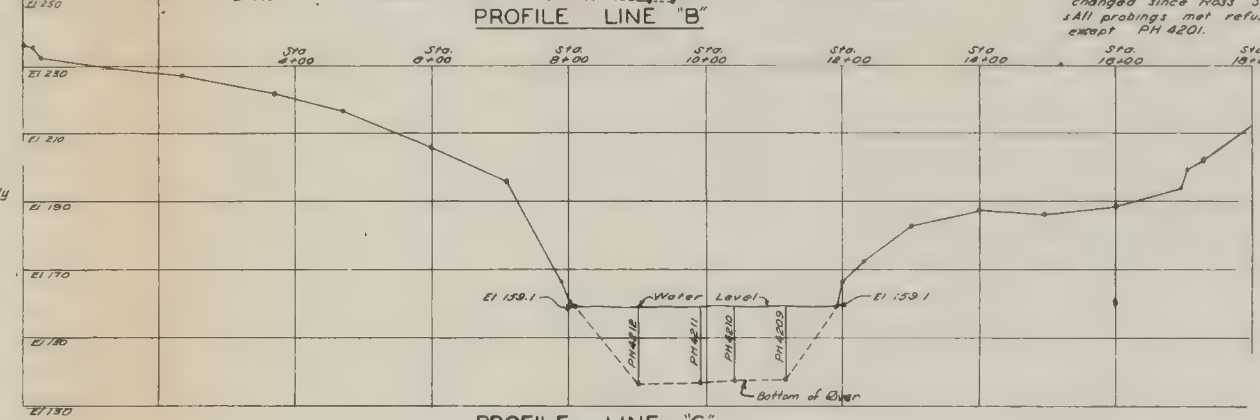
PROFILE LINE "A"

| PROBING | CO-ORDINATES | |
|---|---|---|
| | X | Y |
| PH 4198 | E 361,264.91 | N 1,801,537.65 |
| PH 4199 | E 361,292.37 | N 1,801,462.71 |
| PH 4200 | E 361,333.56 | N 1,801,350.00 |
| PH 4201 | E 361,359.91 | N 1,801,279.56 |
| PH 4202 | E 363,941 | N 1,803,774 |
| PH 4203 | E 363,951 | N 1,803,864 |
| PH 4204 | E 363,956 | N 1,803,909 |
| PH 4205 | E 363,968 | N 1,803,938 |
| PH 4206 | E 363,973 | N 1,804,059 |
| PH 4207 | E 363,983 | N 1,804,148 |
| PH 4208 | E 363,988 | N 1,804,193 |
| PH 4209 | E 365,632 | N 1,805,118 |
| PH 4210 | E 365,673 | N 1,805,055 |
| PH 4211 | E 365,701 | N 1,805,013 |
| PH 4212 | E 365,750 | N 1,804,938 |
| D1267 | E 363,910 | N 1,804,200 |
| D1268 | E 364,030 | N 1,803,757 |



PROFILE LINE "B"

**NOTES:**
Analyses of overburden are based on dry samples. Analyses of rock are based on 2⅛" cores obtained by drilling.
Profiles looking West
Scale: 1"=100' Horiz ; 1"=20' Vert.
Profile elevations do not agree with plan as cross section of Grass River has been changed since Ross Survey
All probings met refusal on probable rock except PH 4201.



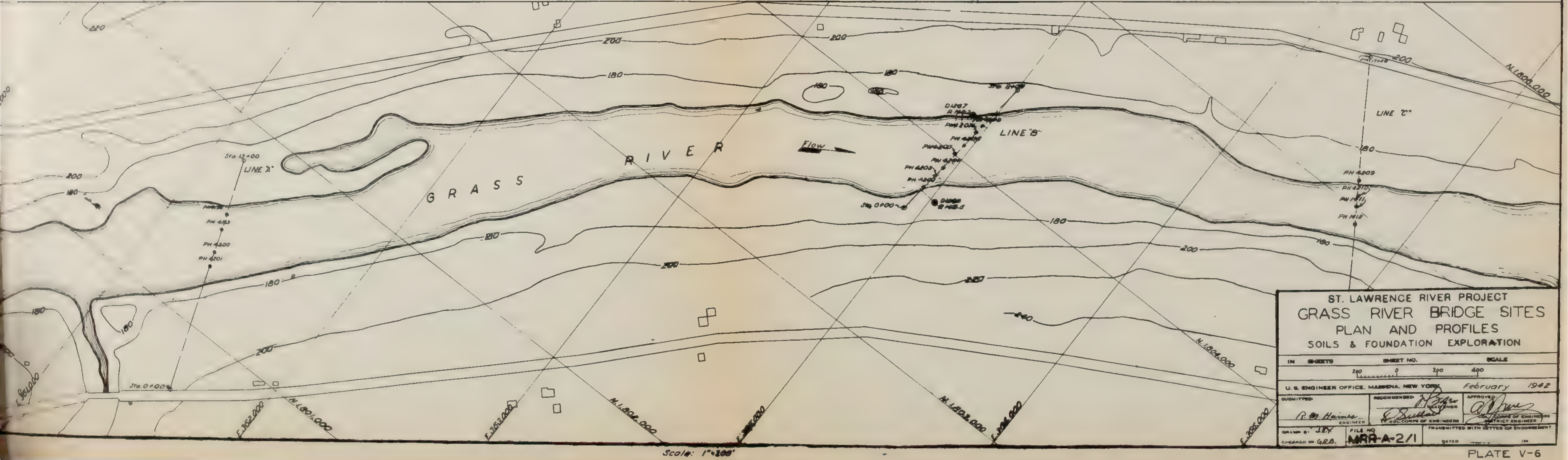
PROFILE LINE "C"

LEGEND
- ▲ Center of seismic line
- ● Drill Hole
- • Probe Holes

DESCRIPTIVE TERMS
Slightly silty etc. denotes approximately 1% to 20% by dry weight of silt etc.

Silty etc. denotes approximately 20% to 40% by dry weight of silt etc.

Silt & sand etc. denotes approximately 40% to 60% by dry weight of silt etc. except "and clay" denotes more than 30% by dry weight of clay.



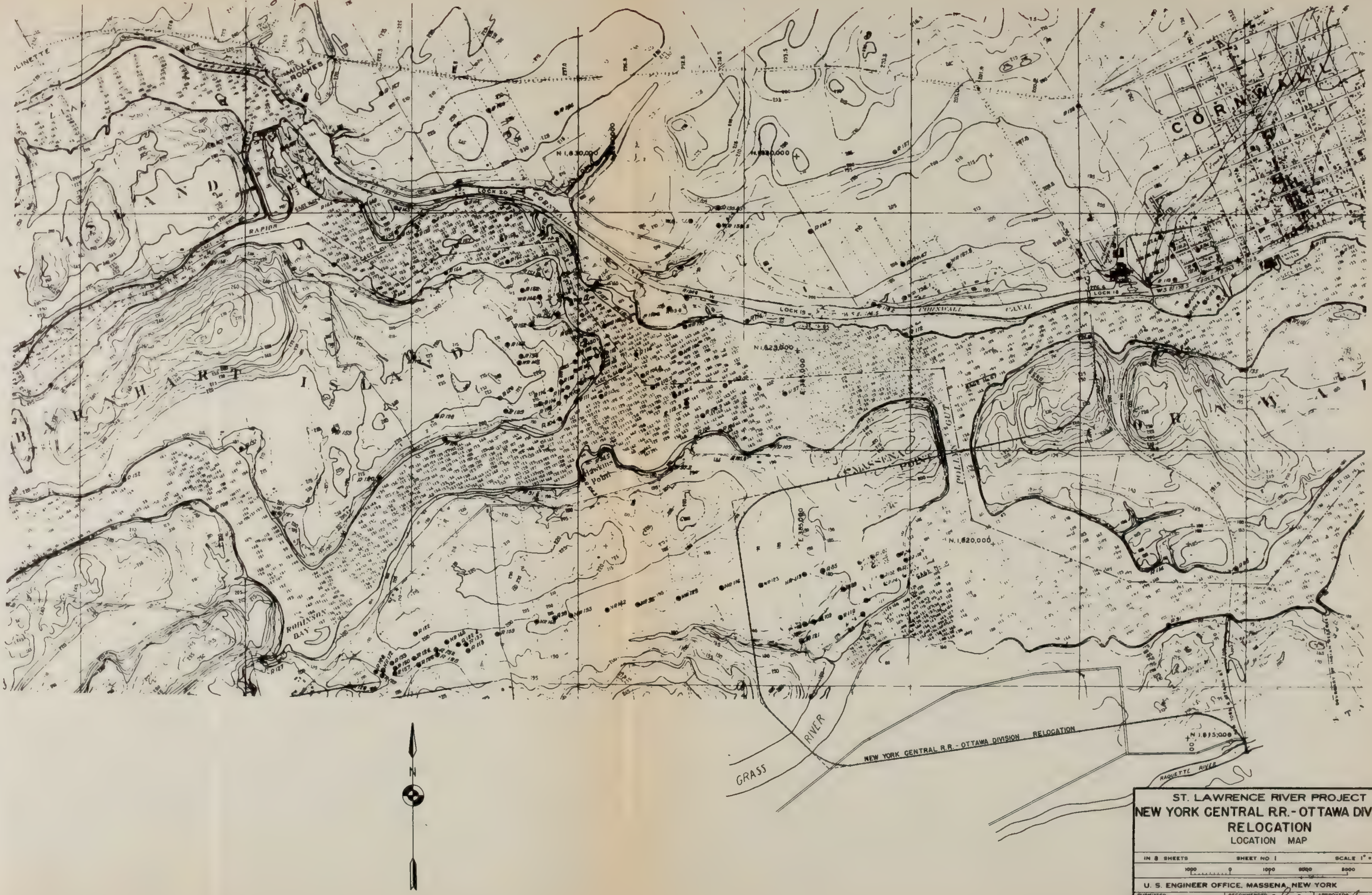
ST. LAWRENCE RIVER PROJECT
GRASS RIVER BRIDGE SITES
PLAN AND PROFILES
SOILS & FOUNDATION EXPLORATION

| IN SHEETS | SHEET NO. | SCALE |
|---|---|---|
| | | 200 0 200 400 |

U. S. ENGINEER OFFICE, MASSENA, NEW YORK February 1942

| SUBMITTED: | RECOMMENDED: | APPROVED: |
|---|---|---|
| R. M. Haines<br>ENGINEER | HEAD ENGR.<br>LT. COL. CORPS OF ENGINEERS | COL. CORPS OF ENGINEERS<br>DISTRICT ENGINEER |
| DRAWN BY: J.E.K.<br>CHECKED BY: G.R.B. | FILE NO. MRR-A-2/1 | TRANSMITTED WITH LETTER OF ENDORSEMENT<br>DATED 194 |

PLATE V-6



ST. LAWRENCE RIVER PROJECT
NEW YORK CENTRAL R.R. - OTTAWA DIVISION
RELOCATION
LOCATION MAP

IN 8 SHEETS SHEET NO 1 SCALE 1" = 1000'

1000 0 1000 2000 3000

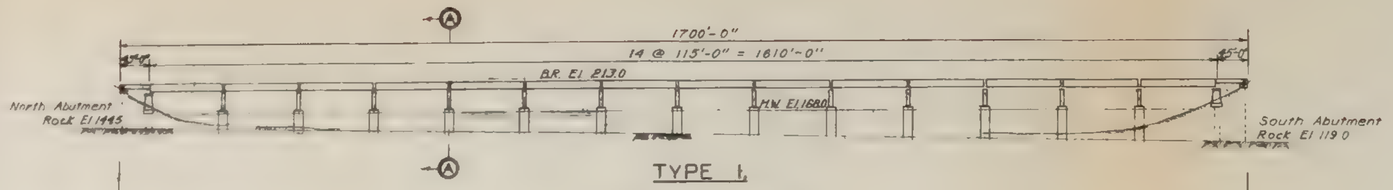
U. S. ENGINEER OFFICE, MASSENA, NEW YORK

| SUBMITTED | RECOMMENDED | APPROVED |
|---|---|---|
| H. A. Fay<br>PRIN. ENGINEER | D. Sullivan<br>LT.COL. CORPS OF ENGINEERS<br>HEAD ENGR | COL. CORPS OF ENGINEERS<br>DISTRICT ENGINEER |

DRAWN BY C H S
CHECKED BY J M P
CMRR-1-1/1
FILE NO
TRANSMITTED WITH LETTER OR ENDORSEMENT
DATED 1942

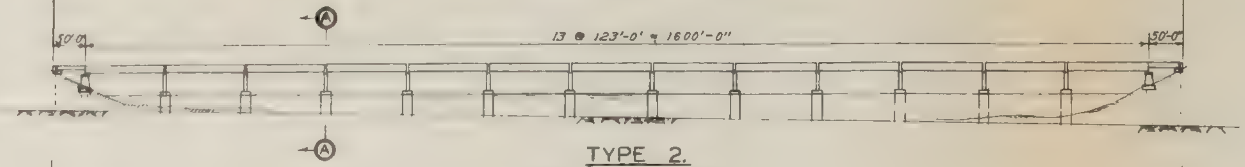
WAR DEPARTMENT

CORPS OF ENGINEERS, US ARMY



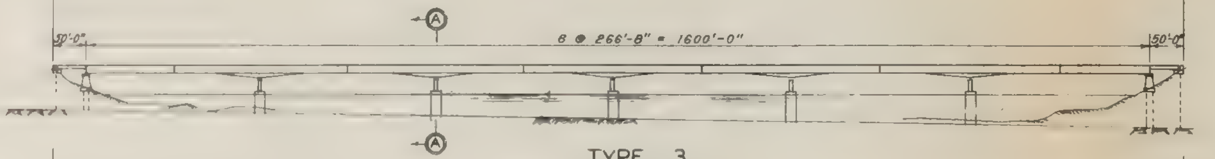
TYPE 1.

DECK PLATE GIRDERS



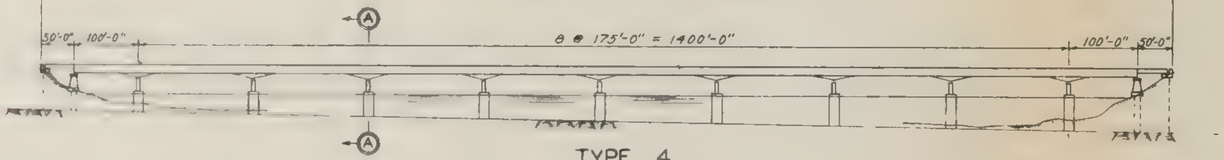
TYPE 2.

DECK PLATE GIRDERS



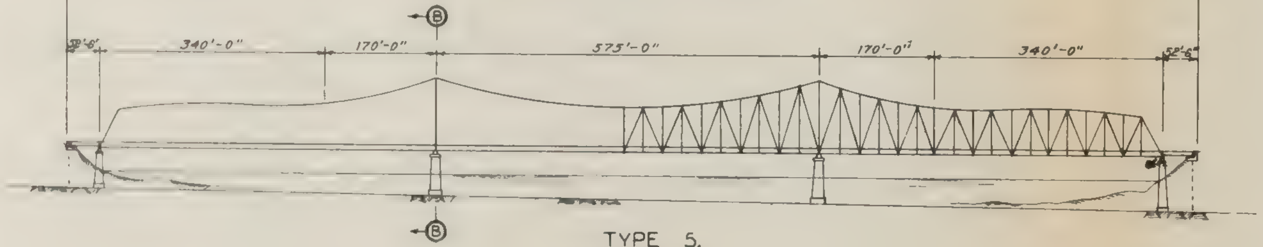
TYPE 3.

CONTINUOUS DECK PLATE GIRDERS



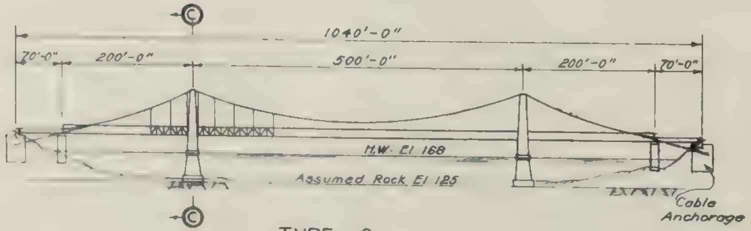
TYPE 4.

COTINUOUS DECK PLATE GIRDERS



TYPE 5.

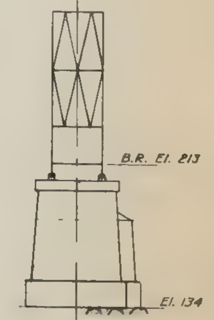
CANTILEVER



TYPE 6.

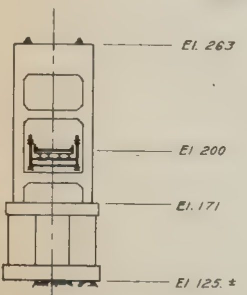
SUSPENSION

SCALE 1" = 100'-0"



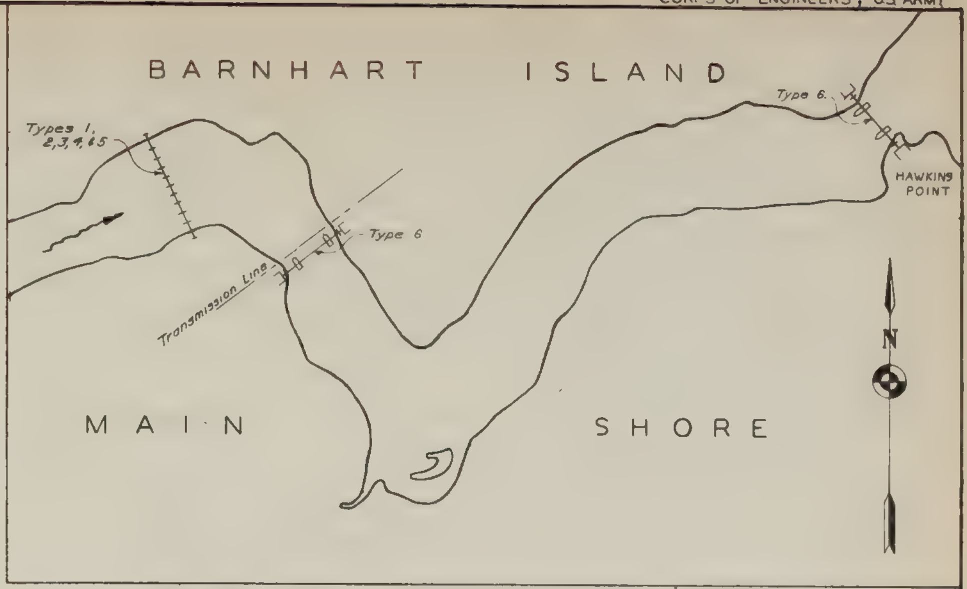
SECTION B-B

SCALE. 1" = 40'-0"



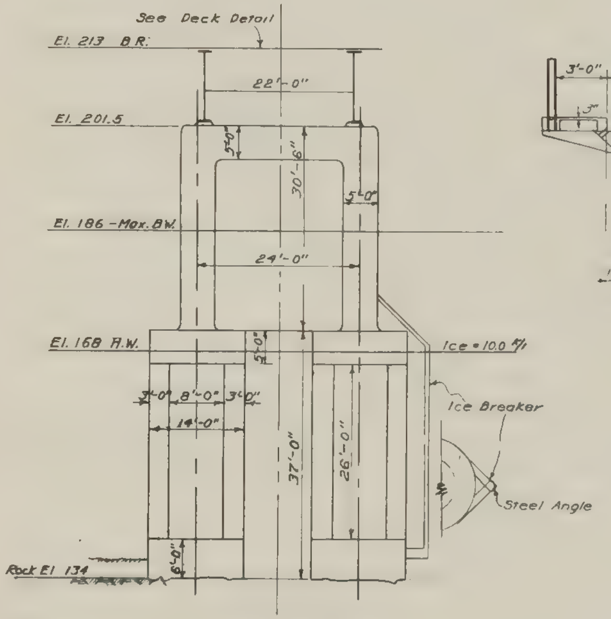
SECTION C-C

SCALE: 1" = 40'-0"



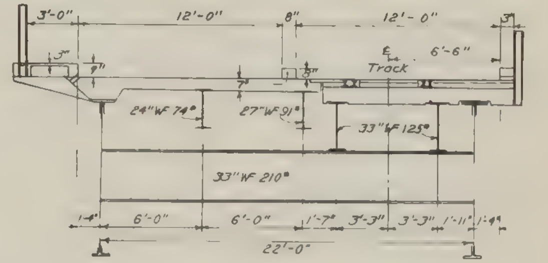
LOCATION PLAN

SCALE 1" = 1000'-0'



SECTION A-A

SCALE 1" = 10'-0"



DETAIL OF DECK (Types 1 to 4 incl)

SCALE ¼" = 1'-0"

General Notes:

Loading: Highway H-20
Railroad E40

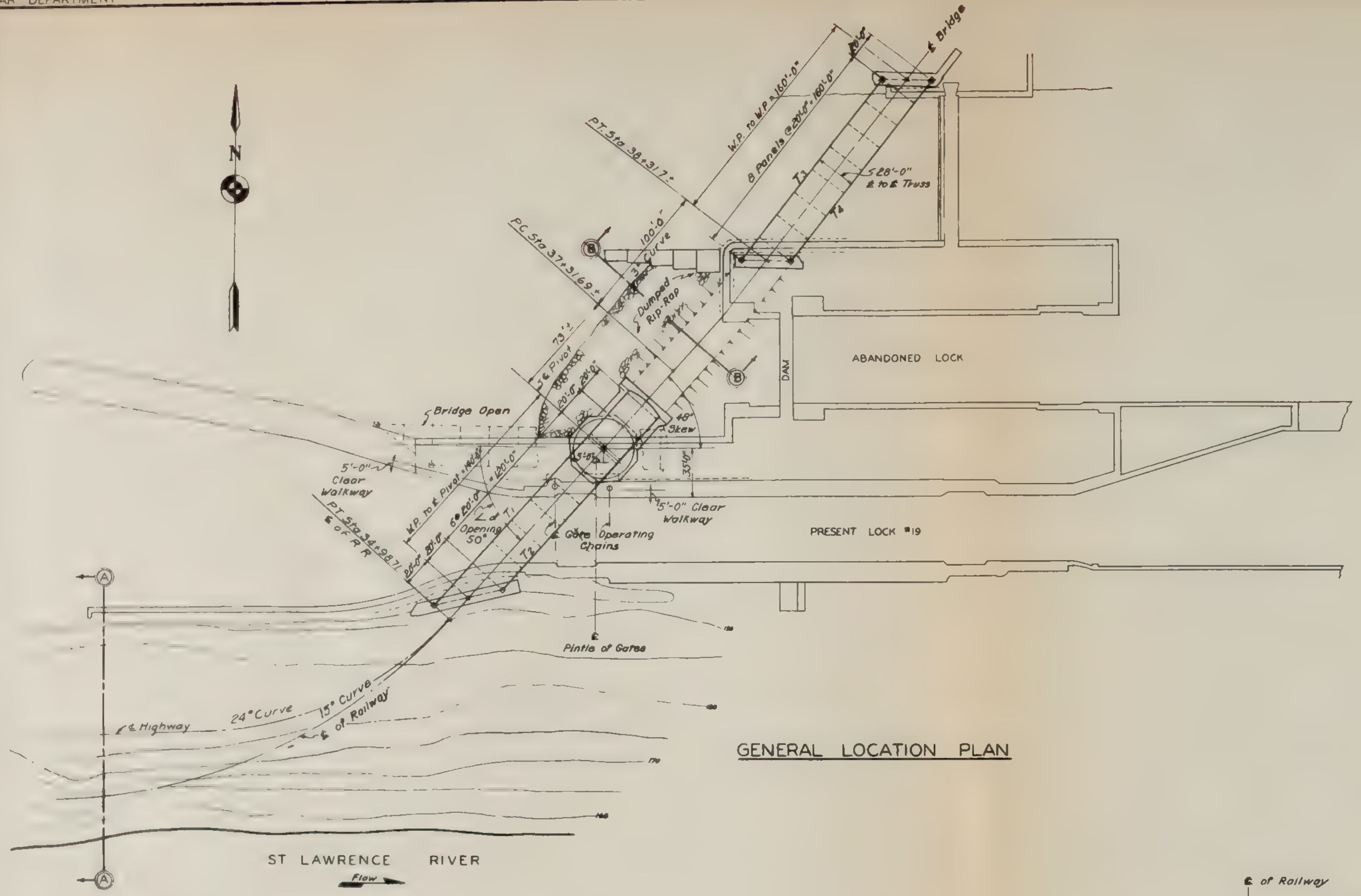
ST LAWRENCE RIVER PROJECT

ACCESS TO BARNHART ISLAND

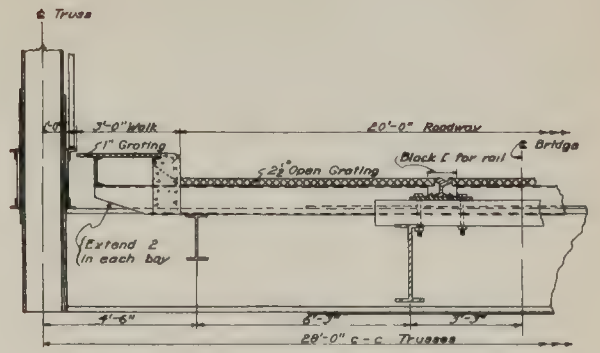
TYPICAL BRIDGES & LOCATIONS

COMBINED R.R. & HWY. BRIDGE

| | | |
|---|---|---|
| IN 1 SHEETS | SHEET NO 1 | SCALE: AS NOTED |
| 1000 0 1000 2000 | | |
| U.S. ENGINEER OFFICE, MASSENA, NEW YORK. | JUNE 25, 1941 | |
| SUBMITTED:<br>SR. ENGINEER | RECOMMENDED:<br>HD. ENGR.<br>LT. COL. CORPS OF ENGINEERS | APPROVED:<br>COL. CORPS OF ENGINEERS<br>DISTRICT ENGINEER |
| DRAWN BY: A.A.C.<br>CHECKED BY: [illegible] | FILE NO.<br>MBRR-R-90/1 | TRANSMITTED WITH LETTER OR ENDORSEMENT<br>DATED ............ 194 |

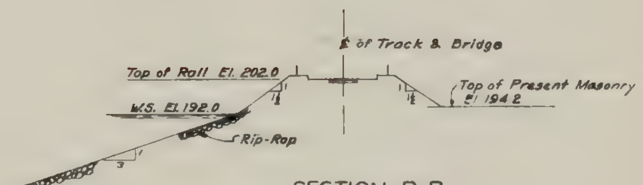


GENERAL LOCATION PLAN



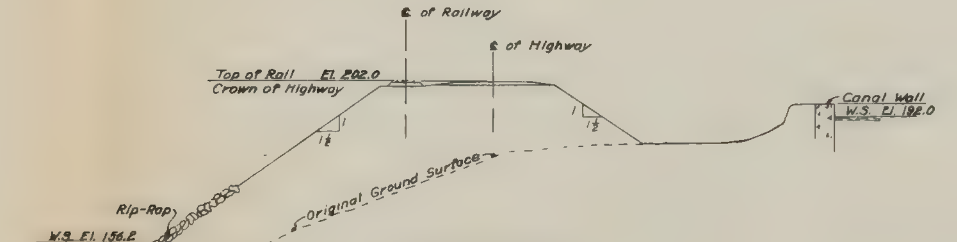
HALF SECTION OF FLOOR

SCALE: ½" = 1'-0"



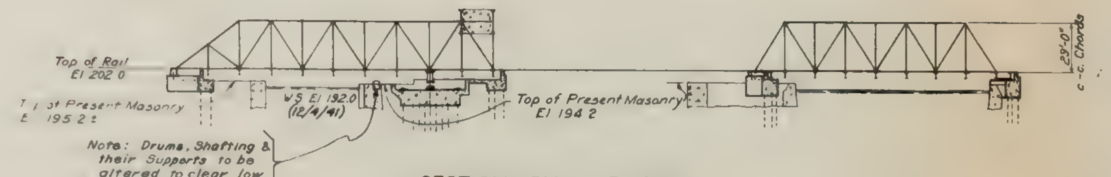
SECTION B-B

SCALE: 1" = 20'



SECTION A-A

SCALE · 1" = 20'


Top of Rail El 202.0
Top of Present Masonry El 195.2±
W.S. El 192.0 (12/4/41)
Top of Present Masonry El 194.2
29'-0" c-c Chords
Note: Drums, Shafting & their Supports to be altered to clear low Steel of Bridge.

SECTION ON ℄ BRIDGE

ST. LAWRENCE RIVER PROJECT
BARNHART ISLAND POWER HOUSE
CANADIAN ACCESS HIGHWAY & RAILROAD
LOCK NO. 19 BRIDGE
LOCATION PLAN-SECTION & DETAIL

IN 9 SHEETS SHEET NO. 1 SCALE: 1 IN = 40 FT EXCEPT AS SHOWN

40 0 40 80

U S ENGINEER OFFICE, MASSENA, NEW YORK

SUBMITTED: J. E. Hawes SR. ENGINEER

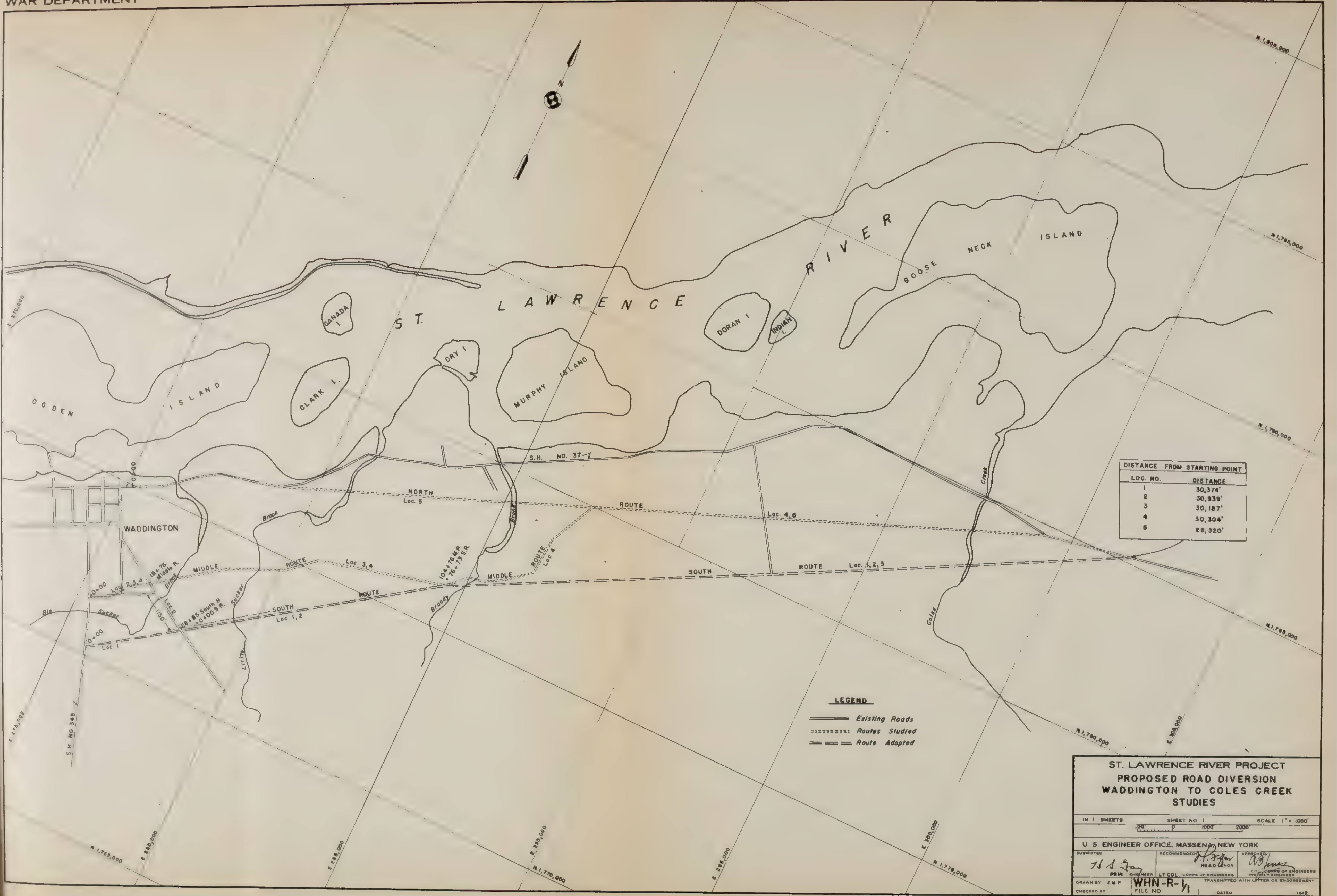
RECOMMENDED: HEAD ENGR. LT. COL., CORPS OF ENGINEERS

APPROVED: COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

DRAWN BY: A.A.C.
CHECKED BY: C S
FILE NO BRY-1-90/1
TRANSMITTED WITH LETTER OR ENDORSEMENT
DATED ______ 194

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



| DISTANCE FROM STARTING POINT | |
|---|---|
| LOC. NO. | DISTANCE |
| 1 | 30,374' |
| 2 | 30,939' |
| 3 | 30,187' |
| 4 | 30,304' |
| 5 | 28,320' |

ST. LAWRENCE RIVER PROJECT

**PROPOSED ROAD DIVERSION**
**WADDINGTON TO COLES CREEK**
**STUDIES**

IN 1 SHEETS SHEET NO 1 SCALE 1" = 1000'

U. S. ENGINEER OFFICE, MASSENA, NEW YORK

SUBMITTED H. S. Fay PRIN. ENGINEER
RECOMMENDED H. Fisher HEAD ENGR LT. COL., CORPS OF ENGINEERS
APPROVED A. B. Jones COL., CORPS OF ENGINEERS DISTRICT ENGINEER
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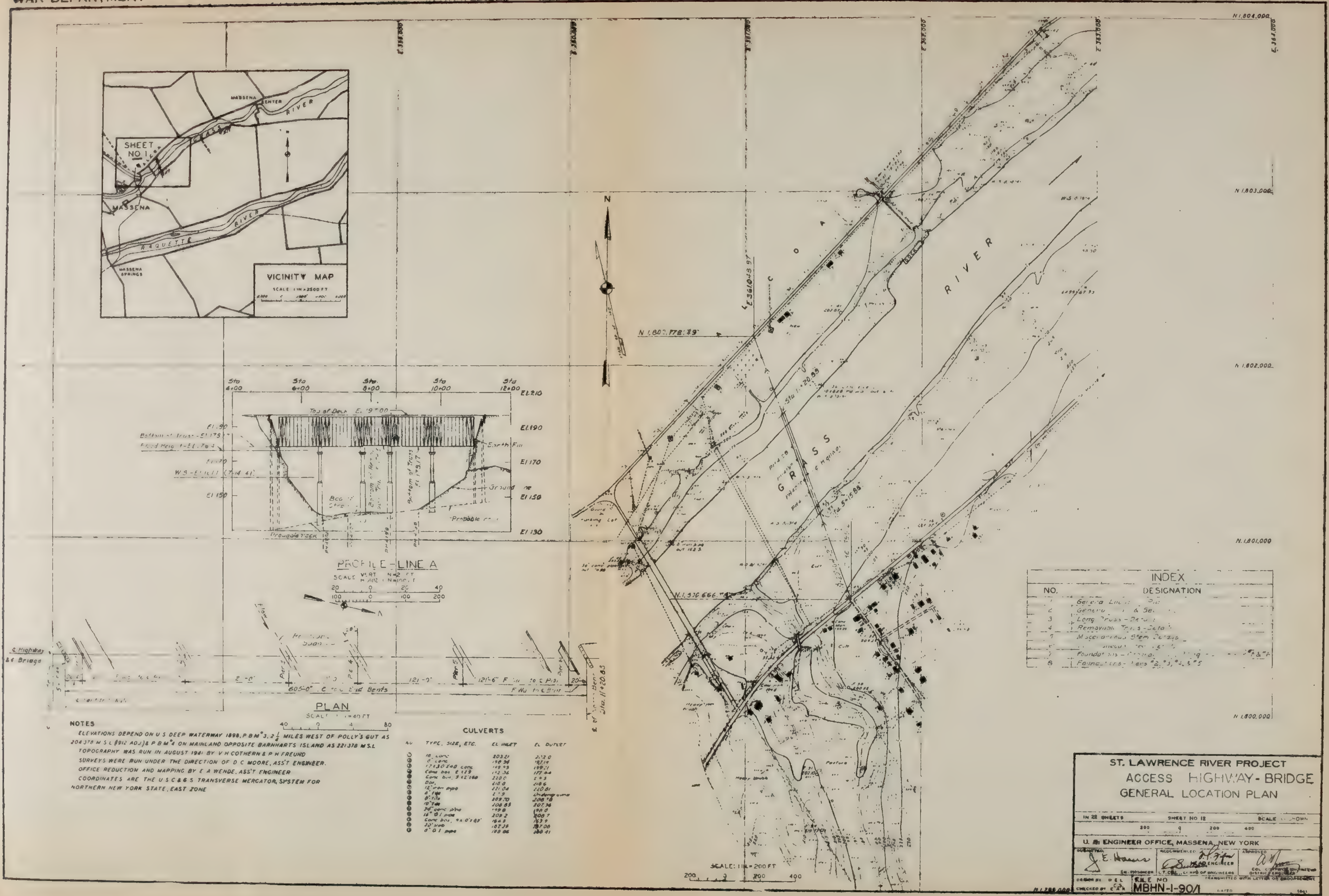
DATED 1948

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



NOTES

ELEVATIONS DEPEND ON U S DEEP WATERWAY 1898, P B M #3, 2 1/4 MILES WEST OF POLLY'S GUT AS 204.378 M S L (1912 ADJ) & P B M #4 ON MAINLAND OPPOSITE BARNHARTS ISLAND AS 221.378 M S L

TOPOGRAPHY WAS RUN IN AUGUST 1941 BY V H COTHERN & P H FREUND

SURVEYS WERE RUN UNDER THE DIRECTION OF D C MOORE, ASS'T ENGINEER.

OFFICE REDUCTION AND MAPPING BY E A WENDE, ASS'T ENGINEER

COORDINATES ARE THE U S C & G S TRANSVERSE MERCATOR SYSTEM FOR NORTHERN NEW YORK STATE, EAST ZONE

CULVERTS

| NO | TYPE, SIZE, ETC. | EL INLET | EL OUTLET |
|---|---|---|---|
| ○ | 18" conc | 203.21 | 202.0 |
| ● | 6" conc | 198.24 | 197.19 |
| ● | 17x30x40 conc | 199.49 | 199.21 |
| ● | Conc box 2 x 3 | 182.36 | 177.44 |
| ● | Conc box, 3 x 12 x 160 | 220.0 | [illegible] |
| ● | Box, | 218.0 | 218.6 |
| ● | 12" iron pipe | 221.04 | 220.81 |
| ● | 6" tile | [illegible] | Underground |
| ● | 6" tile | 209.70 | 208.78 |
| ● | 10" tile | 208.85 | 207.36 |
| ● | 36" conc pipe | 199.0 | 198.0 |
| ● | 16" C I pipe | 209.2 | 208.7 |
| ● | Conc box, 9 x 0 x 95' | 164.5 | 163.9 |
| ● | 30" slab | 187.38 | 187.00 |
| ● | 6" C I pipe | 188.06 | 188.41 |

INDEX

| NO. | DESIGNATION |
|---|---|
| 1 | General Location Plan |
| 2 | General [illegible] & Se[illegible] |
| 3 | Long Truss - Details |
| 4 | Removable Truss - Details |
| 5 | Miscellaneous Steel Details |
| 6 | [illegible] |
| 7 | Foundations - [illegible] #1 & #6 |
| 8 | Foundations - Piers #2, #3, #4, & #5 |

ST. LAWRENCE RIVER PROJECT
ACCESS HIGHWAY - BRIDGE
GENERAL LOCATION PLAN

IN 22 SHEETS | SHEET NO 12 | SCALE AS SHOWN

200 0 200 400

U. S. ENGINEER OFFICE, MASSENA, NEW YORK

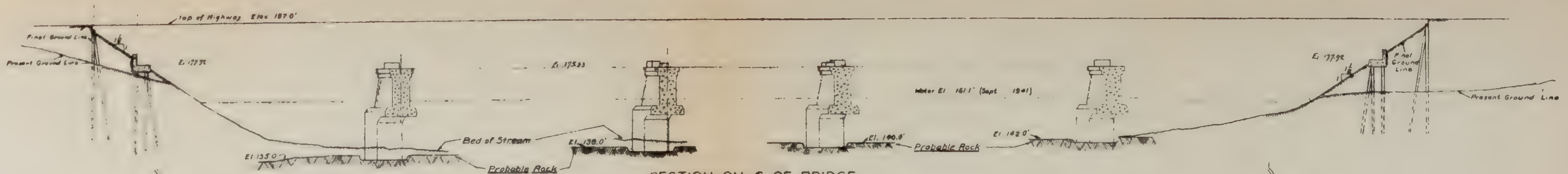
SUBMITTED J. E. Haus SR. ENGINEER
RECOMMENDED HEAD ENGINEER
LT. COL., CORPS OF ENGINEERS
APPROVED
COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

DRAWN BY W E L
CHECKED BY C A R
FILE NO MBHN-1-90/1
TRANSMITTED WITH LETTER OR ENDORSEMENT
DATED 1941

PLATE X-1

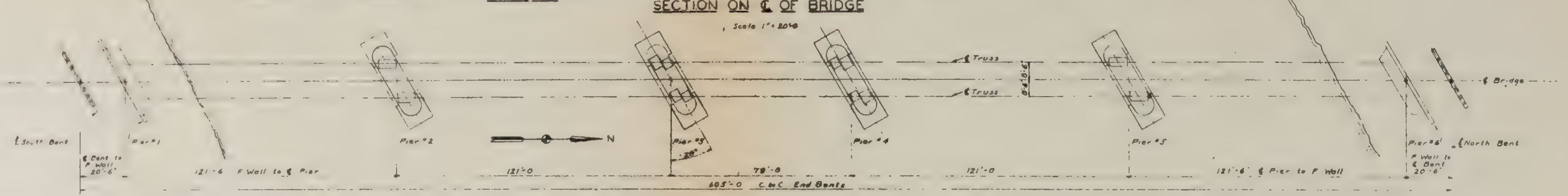
WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



## SECTION ON ℄ OF BRIDGE

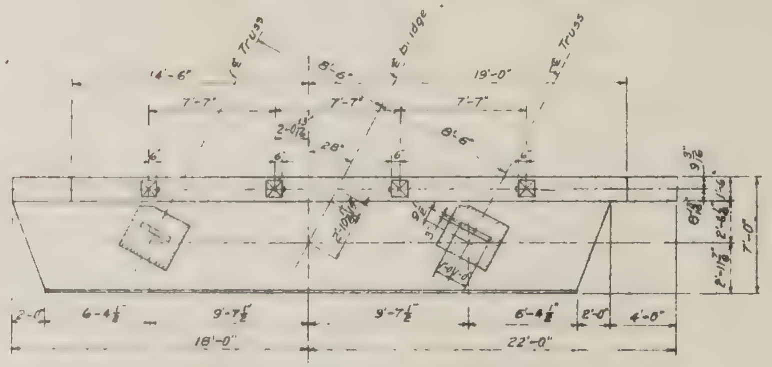
Scale 1" = 20'-0"



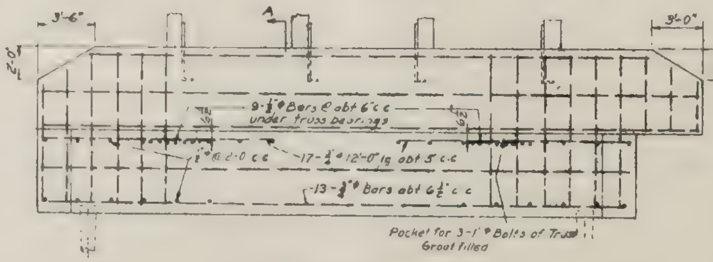
## FOUNDATION PLAN

Scale 1" = 20'-0"

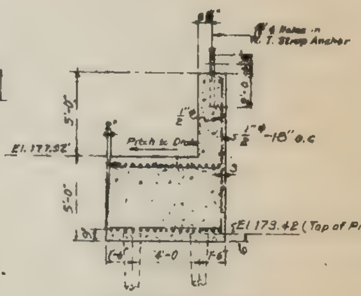
20 0 20 40



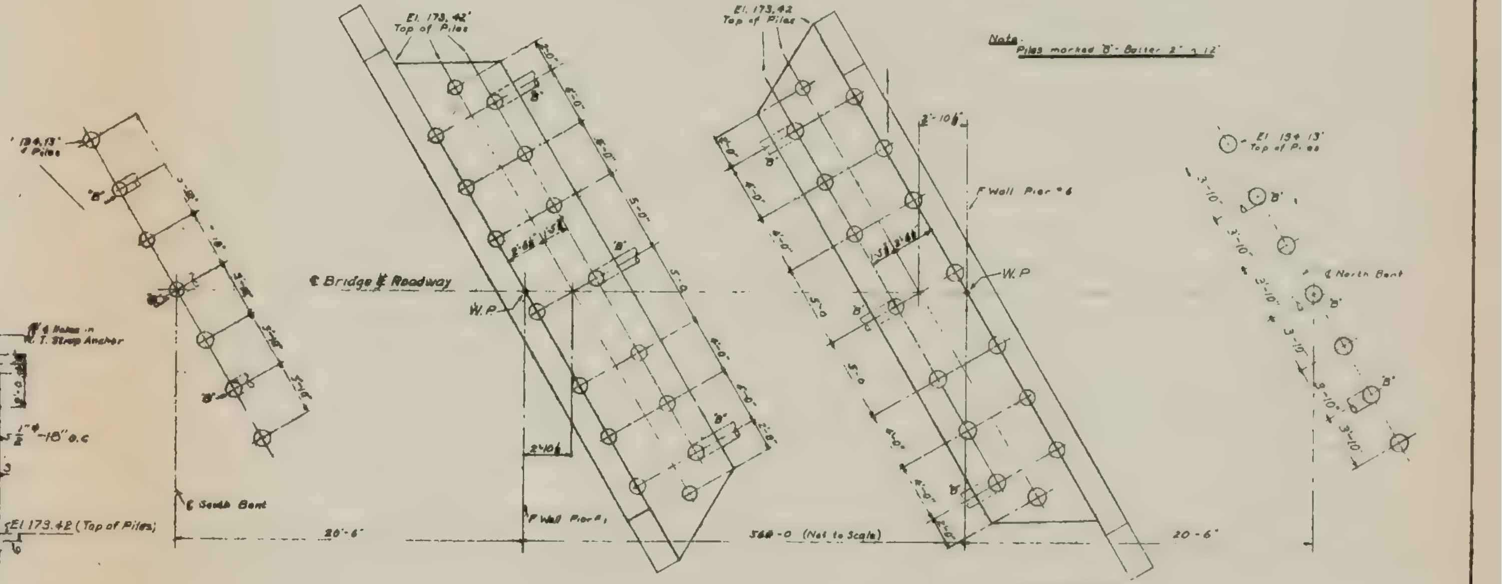
## PLAN OF PIERS #1 & #6


3'-6"
A
3'-0"
2'-0"
1'-8"
9-1/2"φ Bars @ abt 6" c.c. under truss bearings
@ 2-0 c.c.
17-1/2"φ 12'-0" lg abt 5" c.c.
13-1/2"φ Bars abt 6 1/2" c.c.
Pocket for 3-1"φ Bolts of Truss Grout filled

## ELEVATION



## SECTION A-A



## PLAN OF PILING

GENERAL NOTES

SPECIFICATION: The Standard Specifications for Highway Bridges issued by the A.A.S.H.O. dated 1941

CONCRETE: 3000 pounds per sq. in. @ 28 days.

TIMBER PILES: 15 tons Design Load

NOTE:

For reference list of drawings - see Sheet #1

ST. LAWRENCE RIVER PROJECT

**ACCESS HIGHWAY-BRIDGE**

FOUNDATIONS

GENERAL PLAN, PILING PLAN, PIERS #1 & #6

IN 20 SHEETS SHEET NO. 18 SCALE: EXCEPT AS SHOWN

0 4 8 12

U.S. ENGINEER OFFICE MASSENA NEW YORK

SUBMITTED: J. E. Hanna SR. ENGINEER

RECOMMENDED: HEAD ENGR. LT. COL. CORPS OF ENGINEERS

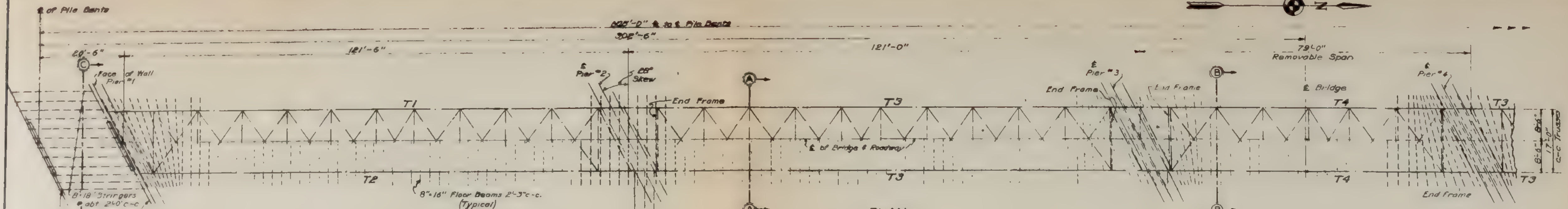
APPROVED: COL. CORPS OF ENGINEERS

DRAWN BY B.B.F.

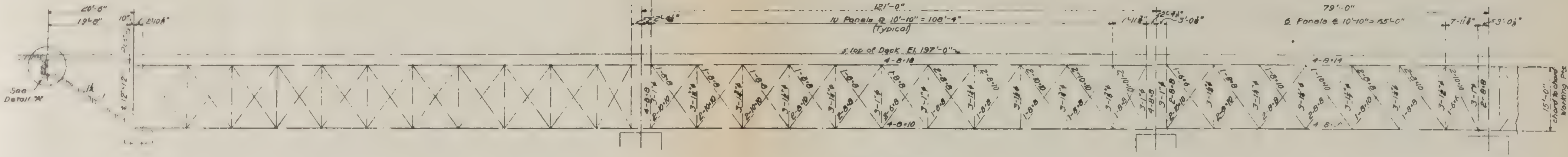
CHECKED BY C.S.

FILE NO. MBHN-I-90/7

DATED 1941

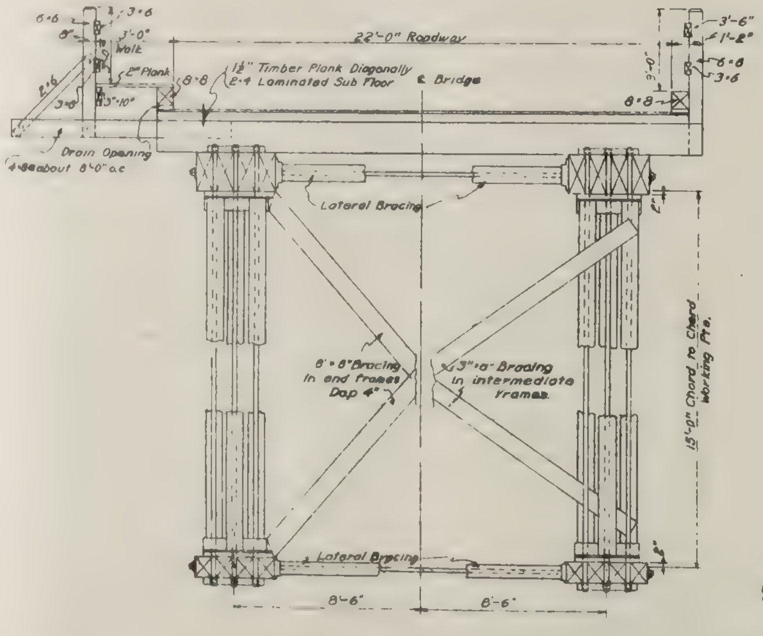


PLAN



20'-6"
19'-8"
10"
2'-10⅛"
2'-4½"
121'-0"
10 Panels @ 10'-10" = 108'-4" (Typical)
1'-11⅜"
2'-4½"
3'-0⅛"
79'-0"
6 Panels @ 10'-10" = 65'-0"
7-11⅜"
3'-0⅛"
℄ Top of Deck El. 197'-0"
4-8×18
4-8×14
4-8×10
15'-0" Chord to Chord Working Pts.
See Detail "A"

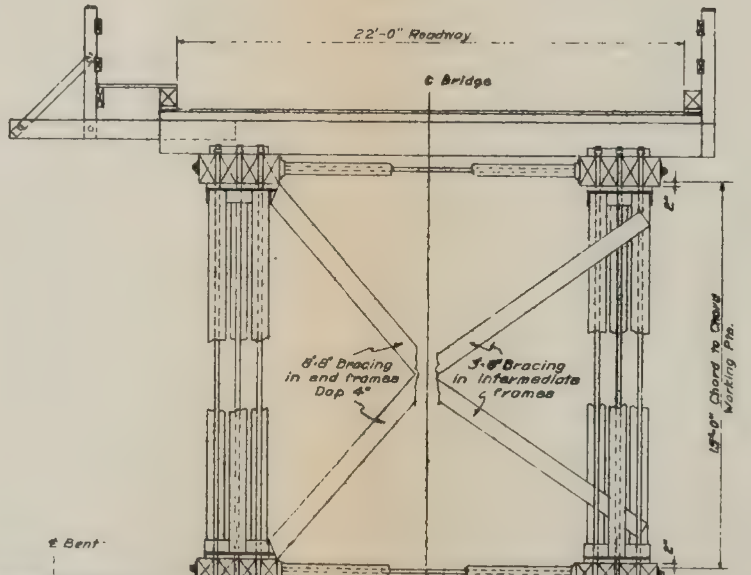
ELEVATION



6×6
3×6
3'-0" Walk
2" Plank
2×6
3×8
3×10
8×8
1½" Timber Plank Diagonally
2×4 Laminated Sub Floor
℄ Bridge
22'-0" Roadway
3'-0"
3'-6"
1'-2"
6×8
3×6
8×8
Drain Opening 4×8 about 8'-0" o.c.
Lateral Bracing
8"×8" Bracing in end frames Dap 4"
3"×8" Bracing in intermediate frames
15'-0" Chord to Chord Working Pts.
2"
2"
Lateral Bracing
8'-6"
8'-6"

SECTION A-A

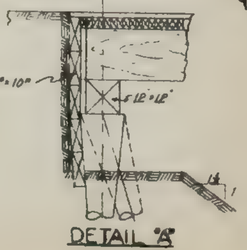
SCALE: ⅛"=1'-0"



22'-0" Roadway
℄ Bridge
8×8 Bracing in end frames Dap 4"
3×8 Bracing in intermediate frames
15'-0" Chord to Chord Working Pts.
2"
2"
8'-6"
8'-6"

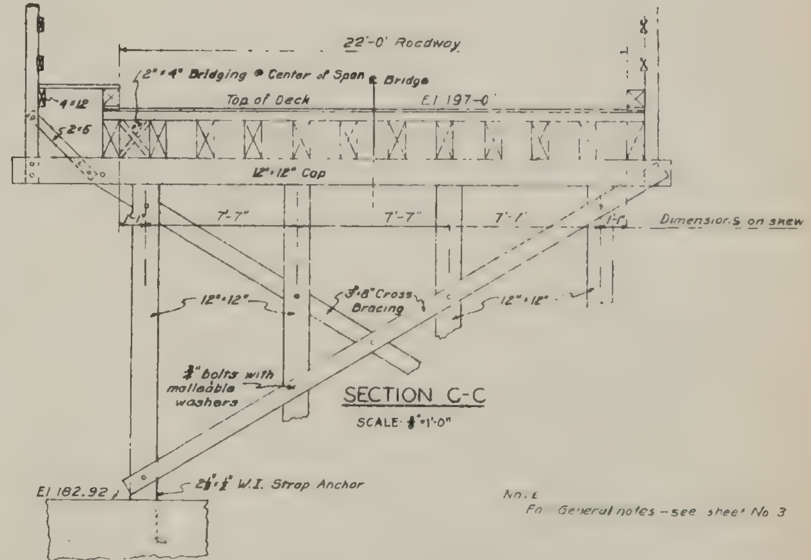
SECTION B-B

SCALE: ⅛"=1'-0"



DETAIL "A"

SCALE: ½"=1'-0"



SECTION C-C

SCALE: ⅛"=1'-0"

Note:
For General notes – see sheet No 3

ST. LAWRENCE RIVER PROJECT
ACCESS HIGHWAY-BRIDGE
SUPERSTRUCTURE
GENERAL PLAN & SECTIONS

IN 22 SHEETS SHEET NO 13 SCALE AS SHOWN EXCEPT AS SHOWN

10 0 10 20

U. S. ENGINEER OFFICE, MASSENA, NEW YORK

SUBMITTED: J. E. Haus, SR. ENGINEER
RECOMMENDED: HEAD ENGR; LT. COL., CORPS OF ENGINEERS
APPROVED: COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

DRAWN BY A.A.C.
CHECKED BY C.S.
FILE NO MBHN-I-90/2
TRANSMITTED WITH LETTER OR ENDORSEMENT
DATED 1941

# SUBSURFACE INVESTIGATIONS FOR NAVIGATION CHANNELS AND HYDRAULIC CUTS

(Pertains to Features 1, 3, 9, 33 and 34)

Report on Subsurface Investigation for Navigation Channels and Hydraulic Cuts.

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12 Plan of Exploration
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### Vicinity of Cornwall Island

26,27 Plan of Exploration
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29,30 Probing Results

### General

31 Photograph of Glacial Till Core
32 Grain Size Curve of Till

# REPORT ON SUBSURFACE INVESTIGATIONS FOR NAVIGATION CHANNELS AND HYDRAULIC CUTS

## I. INTRODUCTION

1. Scope of Report and Investigation. - In the Final Report, 1942, for the St. Lawrence River Project, there is included a discussion of the proposed navigation channels and canals, and hydraulic cuts. During the study of the proposed channels and cuts, field exploration, laboratory investigations and geological studies were made between October 1940 and December 1941 to determine the subsurface conditions at the various sites. The results of these investigations have not been presented in the body of the final report. Investigations for some of the canals and cuts, namely Point Rockway Canal and Cuts "C", "G", and "F" through Long Sault Island were sufficiently extensive to permit final design to be made. The investigations conducted at these sites are discussed in detail in the Analyses of Design for the Long Sault Canal, Long Sault Dam, Iroquois Dam, and the Point Rockway Lock, which are included as appendices to the final report. The purpose of this report is to describe and present the results of subsurface investigation conducted at sites of other cuts and channels for which final designs are not complete. The investigations conducted at sites described herein were mainly of a preliminary nature. At some of the sites, particularly in the region of Galop Island, the design of the channels and cuts was radically changed after exploration was completed and most of the investigations located according to initial layouts are confined to limited areas of the present channels. For the purpose of discussion, the location of the channels and cuts are shown on the exploration maps included herein by the slope toe lines.

2. General Geology. - The St. Lawrence Valley is a region of low relief which has been greatly modified by glaciation and subsequent marine invasion. As the glacier advanced southward over the region, it scraped off the old residual soil and some of the bedrock. This material picked up by the ice was carried mostly in the bottom part of the glacial ice. When the bottom ice became overloaded with debris, this material was "plastered" on the bedrock surface to form lenticular hills or ridges. Later, when the ice melted, the debris carried in and on top of the ice was dropped on the more compact material below. The land was depressed below sea level by the tremendous load of the ice mass so when the ice melted back far enough to uncover the mouth of the St. Lawrence Valley, the sea flooded the region. Wave action on the exposed till hills which appeared as islands in the inland sea produced beaches and bars on the slopes. In the deeper water between the till hills, silt and clay were laid down to fill the valleys and decrease the relief left by the glacier. The land rose slowly rebounding from relief of the ice load. The sea was thus forced out of the St. Lawrence Valley and the present rivers began their work of downcutting through the glacial and marine deposits. In some places the streams and rivers have cut down to rock but in general rock outcrops in the region are scarce. The low till hills rise above broad, flat valleys which are filled with silt and clay. In some areas the silt and clay is covered to depths of 5 to 15 feet by deposits of fine sand laid down in the shallow waters of the retreating sea. The bedrock of the region is a series of flat-lying sedimentary rocks of Ordovician age consisting of dolomite interbedded with occasional thin strata of limestone, sandstone and shale. The rock is horizontally bedded and is cut by several joint systems. Generally the rock is fairly hard, fresh and unweathered.

3. Field Exploration Prior to October 1940. - Prior to October 1940, investigations were conducted by the Governments of Canada and the United States and various private companies in the area of the St. Lawrence River Project to obtain information for studies and estimates of various layouts and structures. Sufficient exploration and studies were conducted to locate the general plan of the project and the general location of the various channels, cuts and structures. The exploration consisted of drilling holes through the overburden by wash boring and into bedrock with core bits. Some of the field logs of the drilling are on file in the district office. The location of the drilling which is pertinent and in the vicinity of each of the recently explored channels and cuts is shown on the inclosed exploration drawings.

## II. FIELD EXPLORATION SINCE OCTOBER 1940

4. General. - During October 1940 to December 1941, subsurface investigations were conducted for the purpose of obtaining information for more detailed studies and design. The exploration has consisted of geological reconnaissance, drilling in overburden and rock, the determination of bedrock elevation by the seismic method, and probing in overburden. During initial stages of the exploration, most of the proposed sites were explored with detailed seismic exploration was conducted at some of the sites to determine the elevation of bedrock which governed the location of additional drill holes. Drilling was conducted at some of the sites where seismic exploration or preliminary exploration indicated that bedrock was near or above the proposed grade of the cut. Probing was conducted at some of the sites to define the areas and extent of material which could be easily excavated. Sufficient exploration was not completed at all of the sites for final design or contract drawings. The location of the completed exploration is shown on Plates 1, 2, 3, 12, 17, 18, 26, and 27. Complete reports of each drill and probe hole and the notes and computations of the exploration are on file in the district office. The general classification of the overburden and bedrock at each drill hole and the overburden and rate of probing at each probe hole are shown on inclosed plates, which are the record of exploration for each site. All soil samples and rock cores are stored in the district soils laboratory. The elevation and location of all exploration was determined by actual surveys.

5. Drilling. - Holes for the purpose of investigating overburden conditions and the elevation and character of the bedrock were drilled with diamond core drilling equipment using 3½-inch casing in the overburden and a 2-1/8-inch diamond bit to obtain bedrock cores. The holes for which 3½-inch casing were used are numbered between D-1000 and D-1500. Holes drilled specifically to determine the characteristics of the overburden were drilled inside 2½-inch casing and have numbers greater than D-1500. The overburden was dry-sampled using a 2-inch sampling tube inside the 3½-inch casing and a 1½-inch sample tube inside the 2½-inch casing. Dry sampling was attempted at approximately 6-foot intervals or at changes in materials to obtain soil samples, and wash boring between samples was permitted. All drilling done to establish the elevation of the bedrock was carried 20 feet into the rock to be certain that the actual bedrock was reached and to determine the type and condition of the bedrock. A total of 2,890 feet in overburden and 1,160 feet in rock as drilled at the sites of proposed channels and cuts which were explored exclusive of the Long Sault Canal, Point Rockway Canal and cuts "C", "G", and "F" through Long Sault Island (see paragraph 1).

6. Probing. - At several of the sites of channels and cuts where conditions were favorable, exploration was conducted to determine the rate of probing in the overburden and thus determine the extent of deposits of soft or uncompacted materials. Small soil samples were taken which served to indicate the type of overburden encountered. The probing was done with a Hymark probing machine using a 1¼-inch diameter probing pipe with a retractible, closed, pointed end. Samples were taken with a sampler after the closed, pointed end was retracted without pulling the casing. In clay and silt deposits, soil samples were obtained with an open end 3/8-inch pipe. The sampler used in sandy materials was a 3/8-inch closed end pipe with a slot about 2 inches from the end. The sampler was moved up and down and the soil either scraped or washed into the slotted opening. The probing pipe was driven with a hammer weighing 164 lbs. dropping approximately 12 inches at an average rate of 60 per minute. A summary giving the location by sites with the number and total footage of all probing is shown in the following tabulation.

| Site | No. of Probings | Footage (feet) |
|---|---|---|
| The Galop Rapids Channel | 123 | 2,175 |
| Sparrowhawk Point and Toussaints Island Channel | 53 | 711 |
| Channel from Point Three Points to below Canada Island | 41 | 470 |
| Channel below junction of St. Lawrence and Grasse Rivers | 39 | 796 |
| Total | 256 | 4,152 |

7. Seismic. - Seismic investigations were conducted at most of the sites of proposed channels and cuts to determine the elevation of bedrock prior to drilling or to supplement the information from drill holes. The seismic investigation was done under the direction of A. E. Wood, Associate Geologist of the Binghamton District and E. R. Shepard, Senior Physicist, Office of the Chief of Engineers, using the method developed by Mr. Shepard for the investigations on land. (For brief description see article "The Seismic Method of Exploration Applied to Construction Projects" by E. R. Shepard, in The Military Engineer, September - October 1939.) Special subaqueous seismic investigations were conducted at some of the excavation sites to expedite the exploratory program and to obtain elevations of the bedrock surface where drilling would be expensive. Mr. Shepard adapted the conventional seismic methods of land to the requirements of subaqueous conditions by developing special apparatus and technique. The lines were laid out and fired like normal lines on land. The detectors were mounted in waterproof cartridges and were held on the river bottom by special equipment. The explosive charges were dropped at the usual intervals along the line and were carried to the river bottom by sinkers. The results of the lines shot on land are considered within the usual limits of accuracy of seismic methods since no difficulties were encountered. On some of the lines fired the results are questionable because of frost conditions in the overburden, and, therefore, the position of these lines is not shown on the maps. The results of the subaqueous determinations are considered generally comparable in accuracy to the determinations on land. A complete report of the seismic investigations on the St. Lawrence River Project will be placed on file in the district office.

# III. GENERAL CHARACTERISTICS OF OVERBURDEN AND BEDROCK

8. General. - For the purpose of determining the soil conditions and to form a permanent record of the exploration, the soil samples and field records were studied in the district soils laboratory. The soil samples obtained were classified using the M.I.T. scale of classification, and these classifications are recorded in the final report for each of the holes. The grain size distribution of a sufficient number of samples was determined by the usual sieve and hydrometer method to serve as a guide in the classification of all samples. General geological descriptions of the overburden at each drill hole were prepared after studying the laboratory classifications and field logs. The small soil samples obtained with the probing equipment were classified. Only a very general classification of each of these samples was recorded. Moisture content determinations were made on samples of till and clay from the drill holes. The soil testing program did not include shear, consolidation and specific gravity tests. Due to the characteristics of the major part of the overburden, a large program of such tests will not be required for design purposes. However, some excavation will be made in soft marine clays and it will be necessary to determine the stress strain characteristics of the clay before safe and suitable excavation slopes can be designed. The bedrock cores recovered by drilling were classified by a geologist. The condition of the bedrock was determined by an interpretation of the field log and by visual examination. Detailed and general classifications of the rock were recorded in the final report of each drill hole. The general classifications are shown on the records of exploration for each site.

9. The overburden at most of the sites as determined by the field exploration and laboratory studies is mainly glacial till with limited deposits of marine clay and superficial deposits of uniform sands and river gravel and boulders. The bedrock throughout the entire reach of the project is sedimentary and in general the conditions are the same. Since the same till and bedrock conditions occur at many sites, detailed descriptions are given in the following paragraphs to avoid repetition in Sections IV to VII in which detailed Overburden and rock conditions are described for each site.

10. Characteristics of Glacial Till. - The overburden at most of the sites as determined by the investigations described in the above paragraphs is mainly glacial till with limited deposits of marine clay and superficial deposits of uniform sands and river gravel and boulders. The glacial till varies from a clayey to a silty gravelly sand. It is well graded and unstratified. Typical grain size curves are shown on Plate 32. Most of the glacial till contains cobbles and boulders and is very compact. However, some deposits are only moderately compact and in general the top 10 to 20 feet is less compact than the underlying materials. Some of the most compact glacial till encountered was in Ogden Island where the material was so compact that it could be cored with a diamond drill. Plate 31 is a photograph of the glacial till recovered in this manner. The degree of compaction at each drill hole is indicated by the difficulties encountered during drilling and by the velocities obtained by the seismic method. Complete detailed reports of each hole and a detailed report describing

the seismic investigations are on file in the district office. In general, when probings encountered glacial till, the probing was stopped since the number of blows per foot became excessive. The probing pipe often met refusal in glacial till, and, therefore, refusal by probing as noted on the inclosed plates does not necessarily indicate bedrock. The glacial till, in general, has a moisture content between 6 and 12 percent dry weight. It is estimated that the weight of the till varies from 135 to 155 pounds per cubic foot, and that the shearing strength is greater than that determined by an angle of internal friction of 35 degrees.

11. Characteristics of Bedrock. - The bedrock is, in general, fairly hard, unweathered dolomite and limestone with minor amounts of sandstone and shale and is part of the Beekmantown and Chazy formations which are Ordovician in age. The rock is approximately horizontally bedded and is cut by several systems of joints, haphazard in pattern. Where bedrock is exposed or near the ground surface, the upper zone may contain many open joints and bedding planes. In general, no difficulty should be encountered in excavation of the bedrock, and it should break well by blasting.

## IV. CHARACTERISTICS OF OVERBURDEN AND BEDROCK IN THE GALOP RAPIDS CHANNEL (Mile 67 to 74)

12. General. - The Galop Rapids channel extends from the existing deep draft navigation channel near Chimney Point opposite Prescott (Ontario) Terminals to the foot of the Galop Rapids about one mile below Cardinal, Ontario. After the exploration in the vicinity of the channel was completed, the initially proposed channel was modified in alignment and considerably increased in width. The exploration which was planned for the initial narrow channel, therefore, does not adequately provide information for the entire present channel and in some cases the exploration is entirely outside the present channel area. The location, extent, and records of the exploration in the vicinity of the channel are shown on Plates 1 to 9 and 12 to 15. The following paragraphs describe the characteristics of the overburden and bedrock in various sections of the channel as determined by the investigations. The general characteristics of the glacial tills and bedrock in the area are described in paragraphs 10 and 11.

13. Vicinity of Chimney Island. - The overburden in the channel in the vicinity of Chimney Island is mainly variable sand and sandy silt which overlies compact material at a depth of from 2 to 6 feet except in the vicinity of the breakwater for the present north channel where the overlying variable loose material is from 10 to 40 feet in depth. No holes have been drilled in this area, but according to geological evidence and the results of seismic investigations the underlying firm material is glacial till. In th vicinity of Chimney Island there are slabs of rock in the river bed which are apparently a result of wastage from some previous excavation. Bedrock is well below the present proposed grade of elevation 214.

14. Vicinity of Tick Island to Galop Island. - In the area explored, which is shown on Plate 2, the overburden in the vicinity of Tick Island to the east shore of Galop Island is mainly firm material which is believed to be compact glacial till overlain with variable deposits. In the area north and east of Tick Island, the firm material is overlain with slabs

of rock which are apparently a result of wastage from some previous excavation. From Tick Island to within 300 feet of the shore of Galop Island the firm material is overlain to a varying depth from 5 to 30 feet with a variable deposit of soft, silty sand to silty clay. Within 300 feet of the Galop Island shore in the northern part of the present channel the firm overburden is overlain to a depth from zero to 5 feet with loose, variable sand and gravel. In the southern part of the channel in the area not explored between Tick and Galop Islands, it is believed that the overburden is mainly glacial till and is probably overlain by soft deposits. Tick Island is composed almost entirely of glacial till. The bedrock contours in the vicinity of the channel based on seismic investigation and previously drilled holes are shown on Plate 10. Rock is probably above bottom grade elevation along the south side of the channel.

15. North and Through Galop Island. - The investigations on Galop Island were located to study conditions in the vicinity of the initial layout of the channel. The layout of the present proposed channel and the location and extent of exploration is shown on Plates 2 and 3. The overburden in Galop Island is mainly very compact till except in the area explored south of the three points on the north side of the island where clay deposits extend to rock or till. In the channel area in the west side of the island, superficial limited deposits of organic muck occur on the till. The three points on the north side of the island are mainly compact glacial till but in some areas the till is overlain with clay. The recessions between the points are due to erosion of clay deposits which extend to the south. In the coves deposits of clay up to 10 feet in depth occur. The clay deposits are apparently marine in origin and overlie either rock or till. The clay near the surface is fairly firm and in general is underlain by soft clay. The overburden in the river north of the island is mainly soft clay and variable, river deposits of sand, gravel and boulders. In the southern part of the present proposed channel it is believed that the overburden consists of till on the western part of the island and till covered by clay on the eastern part.

16. The configuration of the bedrock in the vicinity of the island is shown by the rock contours on Plate 10. The rock contours are based mainly on the seismic and probing investigation and the few holes drilled into bedrock. The bedrock slopes generally from north to south except in the vicinity of the west side of the island where a buried preglacial valley occurs. Bedrock is exposed between the points on the north side of the island. Plate II is a photograph of the exposed bedrock in the Middle Cove. Rapids occur in the river channel north of the island which are caused by a bedrock barrier.

17. Vicinity of Dixon, Sears, and Baycraft Islands. - The overburden according to the exploration and geological evidence in Dixon, Sears and Baycraft Islands is mainly glacial till. In the explored areas between the islands, firm material is overlain with variable deposits of loose, silty sand and gravel to a depth of 5 to 10 feet. Northeast of Sears Island, a deposit of clay from zero to 20 feet in depth overlies the firm material. Bedrock is below the proposed grade along the northern side of the channel. Rock is generally above grade on the south side of where it rises to elevation 240 near the end of Baycraft Island (see Plate 10).

18. Vicinity of Cardinal Point. - In the channel area in the vicinity of Cardinal Point the overburden consists of 10 to 20 feet of silty sand overlying firm material which is probably glacial till. Rock is below elevation 200 in the vicinity of the point.

19. Vicinity of the North End of Lalone Island. - In the area explored on Lalone Island the overburden is mainly glacial till except in the northwest part where alluvial deposits of fairly loose, gravelly, fine to coarse sand overlies to a depth of 10 to 25 feet the glacial till. In the river channel areas in the vicinity of the north side of the island, the glacial till is overlain with about 5 feet of loose sand, gravel and numerous boulder. The bedrock surface is above grade elevation near the middle of the island along the south side of the channel as shown by the bedrock contours (see Plate 10).

20. Vicinity of the North End of Lotus Island. - The overburden in the vicinity of Lotus Island is mainly compact till. In the river channel, the glacial till is overlain with about 5 feet of loose sand, gravel, and boulders except to the northeast of the island where a shallow deposit of clay occurs. Bedrock in general is below elevation 200 in the vicinity of the channel.

21. Vicinity of Channel South of Lalone and Lotus Islands. - The overburden along the shore of the New York mainland, Lalone and Lotus Islands consists mainly of glacial till. In the river channel it is believed that the overburden consists of sands, gravel and boulders. Bedrock is above grade in the channel south of Lalone Island where rock is exposed above elevation 230 as shown by the rock contours on Plate 10. Rock also appears to be near or above grade east of Lotus Island.

## V. CHARACTERISTICS OF OVERBURDEN AND BEDROCK IN SPARROWHAWK POINT AND TOUSSAINTS ISLAND CHANNEL

(Mile 74 to 76.5)

22. General. - The Sparrowhawk Point and Toussaints Island channel extends from the upstream side of Sparrowhawk Point to the lower end of Toussaints Island. The location, extent, and records of the exploration in the vicinity of the channel is shown on Plates 9 to 16. The following paragraphs describe the characteristics of the overburden and bedrock in various sections of the channel as determined by the investigations. The general characteristics of the glacial till are described in paragraph 10.

23. Vicinity of Sparrowhawk Point. - The location of the channel in the Vicinity of Sparrowhawk Point was changed after the completion of exploration in the area. The completed exploration is pertinent to the north side of the present proposed channel. The overburden in the area where exploration was conducted consists of glacial till which is largely covered by deposits of marine sand, silt and clay. The till is exposed at the surface along the upstream side of the point. A blanket of silt and clay varying from 5 to 40 feet in thickness extends eastward across the entire point from the top of the high bank on the upstream side of the point. The clay deposits are more than 20 feet in depth over the center and eastern side of the point. It is believed that overburden conditions in the area of the point where no exploration was conducted are similar to conditions on

the north side of the proposed channel. In the river channel along the downstream shore of the point, 20 feet of silt and clay overlie deposits of silty sand which rest on till. Bedrock is deeply buried in the entire area.

24. Vicinity of Toussaints Island. - The overburden in the vicinity of Toussaints Island consists almost entirely of compact glacial till. In the river channel near the southeast side of Toussaint Island there are deposits of sand and silt varying in thickness from 15 to 25 feet. Bedrock is below the grade of the proposed channel throughout the entire area.

25. Vicinity of Presqu' Isle. - In the initial proposed layout of the channel in the vicinity of Sparrowhawk Point to Toussaints Island it was proposed to excavate part of Presqu' Isle and exploration was conducted to determine overburden conditions in the area. The overburden was found to consist entirely of glacial till. The channel excavation at this site has been eliminated in the present layout.

## VI. CHARACTERISTICS OF OVERBURDEN AND BEDROCK IN CHANNEL FROM LOWER ENTRANCE POINT ROCKWAY CANAL TO THE UNOBSTRUCTED CHANNEL BELOW CANADA ISLAND - INCLUDING POINT THREE POINTS CUT (Mile 81 to 85)

26. General. - The channel from the lower end of the Point Rockway Canal to the unobstructed channel below Canada Island requires excavation at Leishman's Point, at three locations on the north side of Ogden Island and at Canada Island. Other cuts required in this reach for hydraulic purposes include excavation at Point Three Points on both the United States and Canadian sides of the river and cuts along the Little River on the south side of Ogden Island. The location, extent, and records of the exploration in the vicinity of these sites are shown on Plates 17 to 23. The following paragraphs describe the characteristics of the overburden and bedrock in the various sections of the channels as determined by the investigations. The general characteristics of the glacial till and bedrock are described in paragraphs 10 and 11.

27. Vicinity of Point Three Points. - The overburden on the south side of the river in the vicinity of Point Three Points is entirely glacial till. On the north side of the river the overburden is mainly till in which some pockets of sand occur. In the vicinity of the creek on the north shore the till is covered by deposits of clay up to approximately 15 feet in depth. No exploration was conducted in the river channel but it is believed that the overburden consists of glacial till overlain by deposits of gravel and boulders. Rock is below grade elevation throughout the entire area on both sides of the river.

28. Vicinity of Leishman's Point. - The overburden in the Vicinity of Leishman's Point consists mainly of glacial till. The till is exposed at the surface along the west and north sides of the point. On the eastern shore of the point and extending approximately 500 feet westward the till is blanketed by marine clay to depths of approximately 15 feet. In the river channel upstream and north of the point it is believed that the overburden is glacial till with a cover of sand, gravel and boulders. In the channel between Leishman's Point and the west end of Ogden Island the overburden appears to be glacial till covered to a depth of approximately

10 feet by a blanket of silt and clay. Rock is below grade in the vicinity of the point. Rock contours based on drilling and seismic information in the area are shown on Plate 24.

29. In the initial layout of the project for the vicinity of Leishman's Point, cuts were proposed on the Canadian shore and in New York across the base of the point south of the present proposed cut. Exploration was conducted to determine overburden and rock conditions at both these initially proposed locations. On the Canadian mainland the overburden was found to be entirely a glacial till. Rock is very deeply buried in the area. At the south cut across the base of the point the overburden consists mainly of clay which increases in depth from approximately 15 feet near the low ridge on the western shore of the point to approximately 35 feet near the eastern side. The clay is underlain by glacial till except in the vicinity of the eastern side of the point where the clay rests on rock. Rock contours based on drilling and seismic information are shown on Plate 24.

30. Vicinity of West End of Ogden Island. - The overburden on the west end of Ogden Island in the channel areas consists almost entirely of glacial till. Thin deposits of organic muck occur in the small swale near the western end of the island. In the river channel along the north shore of the island the overburden is mainly glacial till except in the vicinity of the eastern end of the excavation area opposite the end of the approach wall of Lock 24 of the Morrisburg Canal. In this area deposits of clay up to approximately 20 feet in depth were found to occur. Rock is apparently at or close to grade elevation at the western end of the island as shown by the bedrock contours on Plate 24. The rock contours are based on the drilling, seismic and probing information in the vicinity and show a long, low bedrock ridge at the western tip of the island with the rock surface sloping downward to the north and south.

31. Vicinity of the Middle Cut at Ogden Island. - The overburden on Ogden Island in the vicinity of the middle cut is entirely a compact glacial till. Bedrock is above grade elevation 210 along the upstream and northern shore of the point where rock is exposed. Rapids caused by a bedrock barrier occur in the river channel, and a boulder pavement probably rests on the rock. Bedrock contours drawn from rock outcrops, drilling and seismic information are shown on Plate 24.

32. Vicinity of Canada Island and the East End of Ogden Island. - The overburden at the east end of Ogden Island and at Canada Island is entirely compact glacial till. In the river channel near Ogden Island the overburden is believed to consist of sand, gravel and boulders. In the river along the south side of Canada Island deposits of silty sand up to 20 feet in depth occur over firm material. Near the east side of the island in the river are deposits of silty clay approximately 15 feet deep overlying firm material. Rock is well below grade elevation throughout the entire area. Bedrock contours based on drilling and seismic information are shown on Plate 25.

33. Vicinity of the Upper Cut at Little River, South Point of Ogden Island. - The overburden on the south point of Ogden Island, in the vicinity of the proposed hydraulic channel excavation in Little River, consists mainly of fairly compact glacial till with pockets of gravelly sand. Near the downstream end of the proposed excavation the till is overlain by deposits

of silt which are approximately 10 feet in depth. No exploration was done in the river at this location but it is believed that the overburden in the area is clay which overlies till at generally shallow depths. Rock is apparently below grade at the site. Bedrock contours drawn from drilling and seismic information are shown on Plate 24. The bedrock slopes generally southward from the north edge of the proposed cut.

34. In the initial layout of the channel improvement in this area, a cut was also proposed along the New York mainland opposite the cut on Ogden Island. Exploration conducted in this area showed that the overburden consisted mainly of till which is generally covered by 5 to 15 feet of silt. It was found, however, that rock was exposed at the surface along the shore of Little River. Bedrock contours drawn from drilling and seismic data in the area are shown on Plate 24. In the river the overburden is believed to be clay overlying rock or till.

35. Vicinity of Waddington on Little River. - In the channel area on Little River in the vicinity of Waddington, the overburden consists of glacial till and large areas of artificial fill. A ruined mill and a partly collapsed rock fill dam are within the excavation area. Rock is generally shallow throughout the area. The rock is exposed over considerable areas in the stream channel. As shown by the rock contours on Plates 24 and 25, which were drawn from drilling and seismic information and bedrock exposures, rock is at or above grade throughout the entire area.

36. In the initial layout a cut through the middle of Ogden Island was proposed in connection with the Waddington Cut, and exploration to determine overburden and rock conditions was conducted in the area. It was found that the overburden consisted chiefly of glacial till overlain by marine clay ranging from 10 to 15 feet in depth except in the vicinity of Little River where the marine clay extends to rock at a depth of approximately 40 feet. The configuration and elevation of the bedrock in the area is shown by the rock contour map on Plate 24.

37. Morrisburg Canal Dike Removal. - It is proposed to remove the dike for the Morrisburg Canal to enlarge the river channel. Exploration prior to 1940 indicates that rock is below grade elevation in the area, and no exploration was conducted in the vicinity during the present investigation. The large excavation in the vicinity of Morrisburg which was proposed in the initial layout is not believed necessary.

## VII. CHANNEL FROM THE JUNCTION OF THE ST. LAWRENCE RIVER WITH GRASS RIVER TO EXISTING DEEP WATER NAVIGATION IN LAKE ST. FRANCIS AT THE NORTHWEST EXTREMITY OF ST. REGIS ISLAND (Mile 107.6 to 114)

38. General. - The channel from the Grass River to St. Regis Island extends through the south channel of the St. Lawrence River on the south side of Cornwall Island. An enlargement of the river channel is necessary north of Cornwall Island on the Canadian mainland and in the north channel of the St. Lawrence River. The location, extent, and records of the exploration in the vicinity are shown on Plates 26 to 30. The following paragraphs describe the characteristics of the overburden and bedrock in various

sections of the channels as determined by the investigations. The general characteristics of the glacial till and bedrock are described in paragraphs 10 and 11.

39. Vicinity of the Junction of the Grass River and the St. Lawrence River. - The overburden in the channel at the mouth of the Grass River in the Long Sault Canal area has been discussed in the Grasse River Lock Design Analysis. Besides this excavation, it is proposed to make a cut on the point south of the junction of the two rivers. No exploration has been conducted in the cut area, but other exploration and surface evidence indicates that the overburden consists of deep soft silt and clay deposits which extend to rock. In local areas the clay is probably underlain by thin deposits of silty sand. Bedrock is believed to be well below the proposed grade.

40. Vicinity of South Side of Cornwall Island. - On the south side of Cornwall Island in the vicinity of the railroad the overburden consists mainly of glacial till which is overlain by deposits of sand, silt, and clay. Near the railroad bridge the till is covered by approximately 12 feet of sand and silt. Upstream from the bridge, clay deposits approximately 20 feet deep occur over the till, and downstream from the bridge deposits of sand approximately 15 feet in depth blanket soft clay which extends to till at a depth of approximately 30 feet. In the river channel upstream from the island no holes were drilled or probed but it is believed that the overburden is largely silt and clay. Downstream from the island in the river channel no exploration was conducted. Rock is apparently above grade on Cornwall Island upstream from the railroad bridge. It is believed that rock is below grade elevation in the river channel both upstream and downstream from the railroad bridge.

41. Vicinity of Raquette Point. - The overburden on Raquette Point consists mainly of glacial till. In some areas the till is overlain by approximately 15 feet of sand and clay. The sand blankets the clay to a depth of approximately 10 feet. No exploration was conducted in the river channel but it is believed that the burden consists mainly of glacial till. Rock is below grade throughout the area.

42. Vicinity of Lock 18 near Town of Cornwall. - It is proposed to enlarge the channel of the St. Lawrence River north of Cornwall Island in the vicinity of the town of Cornwall. Exploration shows that the overburden on the Canadian mainland is composed entirely of glacial till. In the river channel firm material believed to be glacial till was encountered. Rock is generally at or below grade elevation on the mainlaind. In the river channel it is believed that rock is below grade elevation in most of the excavation area.

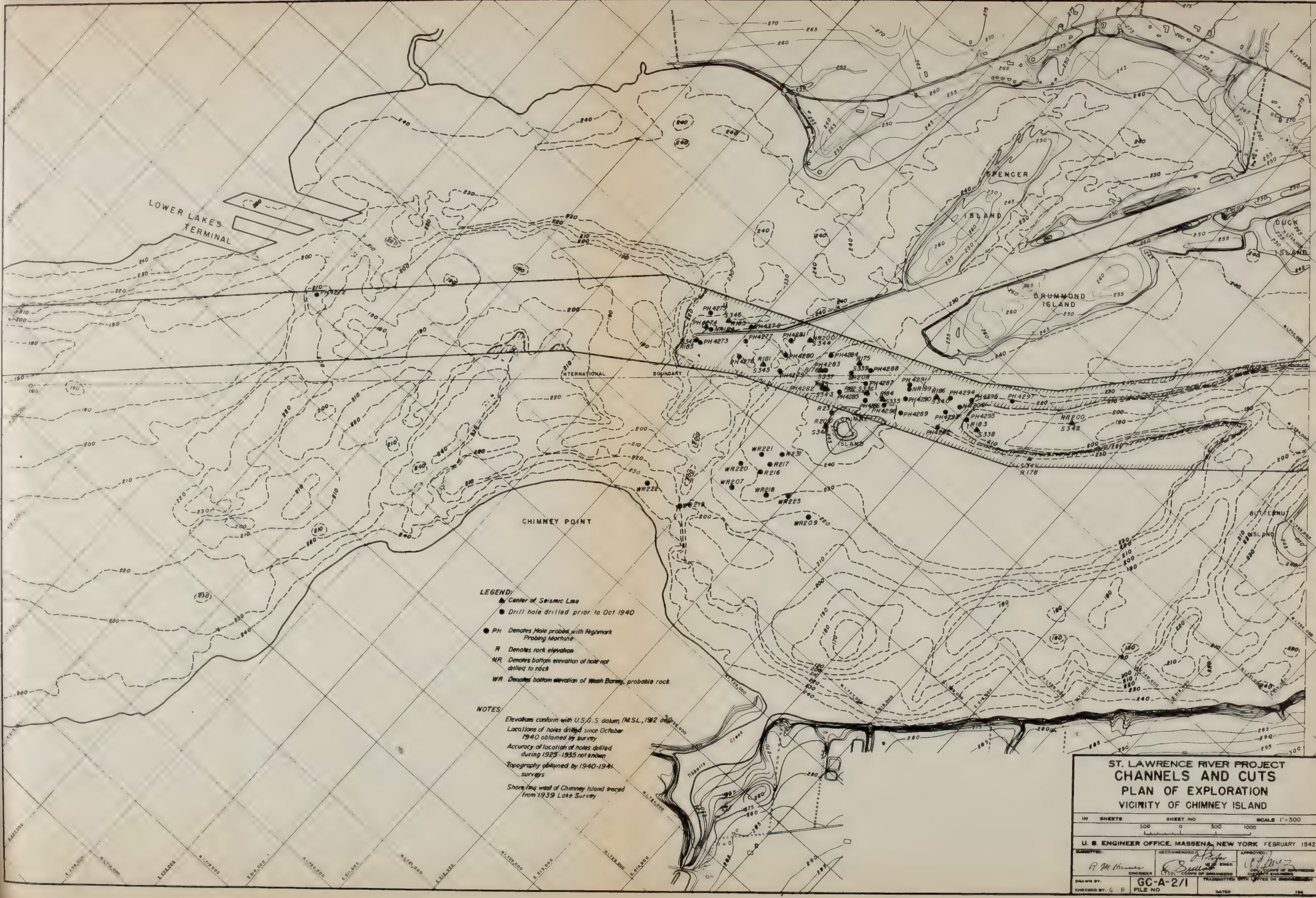
43. Vicinity of East End Cornwall Island South Channel of the St. Lawrence River. - No exploration was conducted in the south channel of the St Lawrence River east of Raquette Point. It is believed, however, that the overburden in the river consists largely of glacial till. Rock is apparently below grade elevation from the railroad bridge on Cornwall Island to St. Regis Island. During initial studies an additional cut was considered through the neck of Cornwall Island in the vicinity of the location of the two seismic lines shown on Plate 27. The exploration indicated that bedrock is about 40

feet below the ground surface. No elevations were determined.

## VIII. RECOMMENDED FUTURE INVESTIGATIONS

44. Field Exploration. -The exploration completed to date at most of the sites must be considered as preliminary. The exploration has furnished data indicating the general character and distribution of overburden in the excavation areas and the general elevation of the bedrock. In those areas where rock is apparently near or above grade or no exploration has been conducted, it is recommended that detailed seismic exploration be conducted. Holes should be drilled in areas where rock, as determined by seismic exploration, is near grade elevation to check the results obtained by the seismic method. It has been found that the drilling program may be greatly limited if preceded by seismic exploration. Due to the variability of the surface deposits, it is recommended that detailed probing exploration be conducted to determine the depth of soft material except on land where it is evident that the overburden at the surface is compact glacial till. In some areas, the probing should precede seismic explorations. Probing investigations may reveal that bedrock is well below grade and that seismic exploration is not necessary. Beside the probing explorations, a few holes should be drilled to obtain soil samples and to determine the general characteristics of the materials. In several areas where deep soft clay deposits exist, undisturbed samples should be taken for testing to determine the shearing strength. It is believed advisable, just prior to construction, to excavate some deep pits in the excavation areas, or if possible, open trenches in exposed faces so that bidders may visually examine the character of the material to be excavated.

45. Laboratory Tests and Designs of Slopes. - Since the greater part of all the excavation slopes will be in glacial till or river sands, the soil testing program will be limited. The major part of the future program will be testing soft clay samples from a few excavation areas to determine the shearing strength for design purposes. Designs should be made for all slopes excavated in deep soft clay. In general, steep slopes in the glacial till will be stable and no design analysis will be necessary. However, in some excavation areas, the ground water may produce unstable slopes if steep in sandy till. These conditions cannot be definitely determined by ordinary field exploration and laboratory tests. It is recommended that no attempt be made to determine these conditions since they will probably exist in limited areas and if difficulty is encountered during construction the slope may be changed at that time.



LEGEND:
▲ Center of Seismic Line
● Drill hole drilled prior to Oct 1940
● PH Denotes Hole probed with Highmark Probing Machine
R Denotes rock elevation
NR Denotes bottom elevation of hole not drilled to rock
WR Denotes bottom elevation of Wash Boring, probable rock.

NOTES:
Elevations conform with U.S.G.S datum (M.S.L., 1912 adj.)
Locations of holes drilled since October 1940 obtained by survey
Accuracy of location of holes drilled during 1925-1935 not known
Topography obtained by 1940-1941 surveys
Shore line west of Chimney Island traced from 1939 Lake Survey

ST. LAWRENCE RIVER PROJECT
CHANNELS AND CUTS
PLAN OF EXPLORATION
VICINITY OF CHIMNEY ISLAND

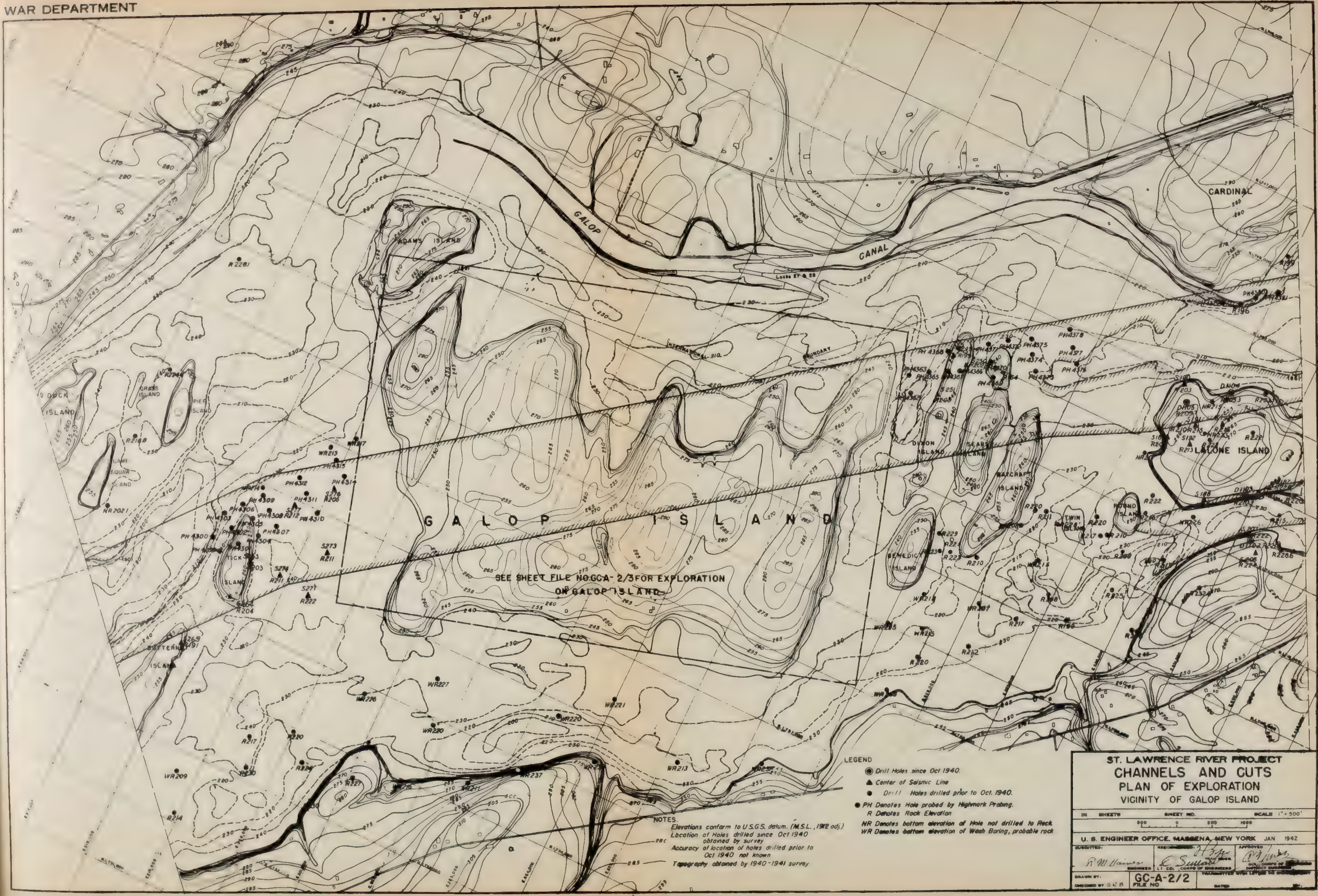
IN SHEETS SHEET NO SCALE 1" = 500
500 0 500 1000

U. S. ENGINEER OFFICE, MASSENA, NEW YORK FEBRUARY 1942

SUBMITTED: R M Haines ENGINEER
RECOMMENDED: LT. COL. CORPS OF ENGINEERS
APPROVED: COL. CORPS OF ENGINEERS DISTRICT ENGINEER

DRAWN BY:
CHECKED BY: G B
GC-A-2/1
FILE NO
TRANSMITTED WITH LETTER OR ENDORSEMENT
DATED 194

PLATE I



LEGEND

◉ Drill Holes since Oct 1940.

▲ Center of Seismic Line

● Drill Holes drilled prior to Oct. 1940.

● PH Denotes Hole probed by Highmark Probing.

R Denotes Rock Elevation

NR Denotes bottom elevation of Hole not drilled to Rock

WR Denotes bottom elevation of Wash Boring, probable rock

NOTES.

Elevations conform to U.S.G.S. datum. (M.S.L., 1912 adj.)

Location of Holes drilled since Oct 1940 obtained by survey

Accuracy of location of holes drilled prior to Oct 1940 not known

Topography obtained by 1940-1941 survey

## ST. LAWRENCE RIVER PROJECT
## CHANNELS AND CUTS
### PLAN OF EXPLORATION
### VICINITY OF GALOP ISLAND

IN SHEETS SHEET NO. SCALE 1" = 500'

500 0 500 1000

U. S. ENGINEER OFFICE, MASSENA, NEW YORK JAN 1942

SUBMITTED: R M Haines ENGINEER

RECOMMENDED: E. Sullam LT COL CORPS OF ENGINEERS

APPROVED: COL CORPS OF ENGINEERS DISTRICT ENGINEER

TRANSMITTED WITH LETTER OF

DATED

DRAWN BY:

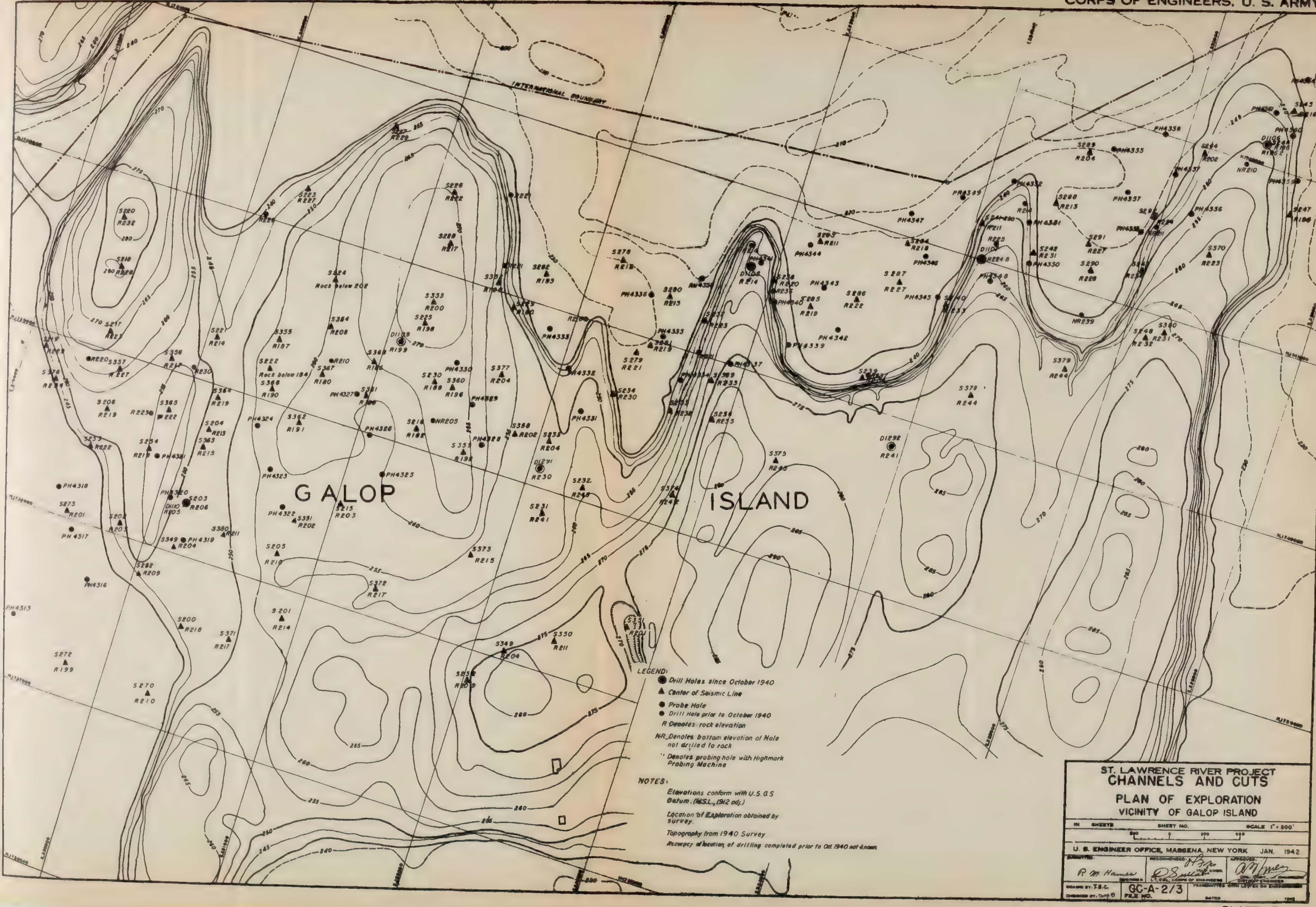
CHECKED BY G R B

GC-A-2/2
FILE NO

PLATE 2

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



LEGEND:

- ● Drill Holes since October 1940
- ▲ Center of Seismic Line
- ● Probe Hole
- ● Drill Hole prior to October 1940
- R Denotes rock elevation
- NR Denotes bottom elevation of Hole not drilled to rock
- '' Denotes probing hole with Highmark Probing Machine

NOTES:

Elevations conform with U.S.G.S Datum. (M.S.L., 1912 adj.)

Location of Exploration obtained by survey.

Topography from 1940 Survey

Accuracy of location of drilling completed prior to Oct. 1940 not known.

ST. LAWRENCE RIVER PROJECT
CHANNELS AND CUTS
PLAN OF EXPLORATION
VICINITY OF GALOP ISLAND

IN SHEETS SHEET NO. SCALE 1" = 200'

U. S. ENGINEER OFFICE, MASSENA, NEW YORK JAN. 1942

SUBMITTED: R M Hames ENGINEER

RECOMMENDED: LT. COL. CORPS OF ENGINEERS

APPROVED: DISTRICT ENGINEER

DRAWN BY: T.S.C.
CHECKED BY:

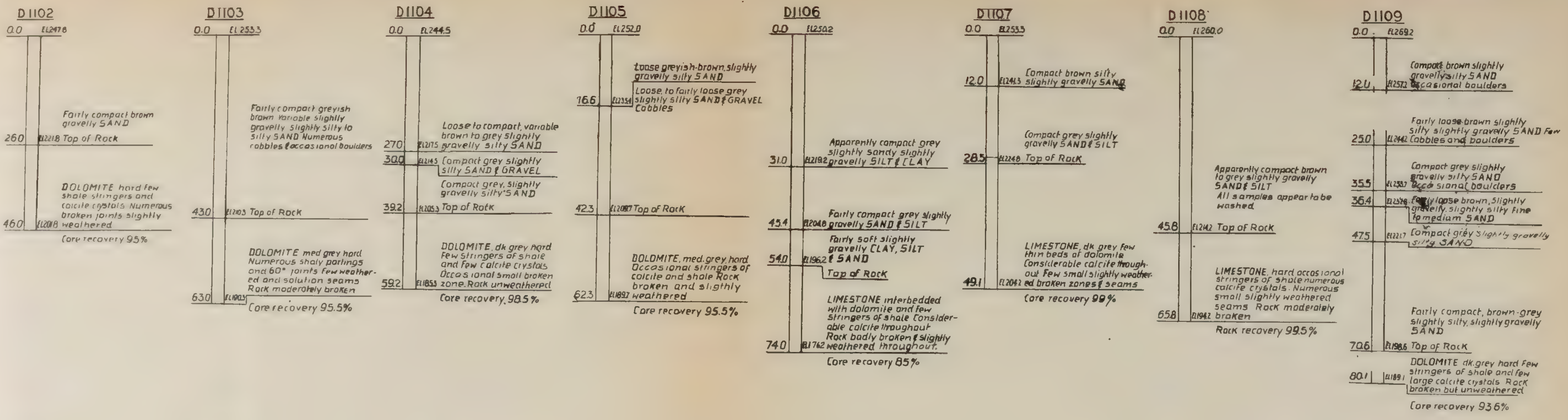
GC-A-2/3
FILE NO.

TRANSMITTED WITH LETTER OR ENDORSEMENT
DATED 1942

PLATE 3

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



**D1102**

| Depth | Elevation | Description |
|---|---|---|
| 0.0 | El 247.8 | |
| 26.0 | El 221.8 | Fairly compact brown gravelly SAND<br>Top of Rock |
| 46.0 | El 201.8 | DOLOMITE hard few shale stringers and calcite crystals Numerous broken joints slightly weathered |

Core recovery 95%

**D1103**

| Depth | Elevation | Description |
|---|---|---|
| 0.0 | El 253.3 | |
| 43.0 | El 210.3 | Fairly compact greyish brown variable slightly gravelly slightly silty to silty SAND Numerous cobbles & occasional boulders<br>Top of Rock |
| 63.0 | El 190.3 | DOLOMITE med grey hard Numerous shaly partings and 60° joints few weathered and solution seams Rock moderately broken |

Core recovery 95.5%

**D1104**

| Depth | Elevation | Description |
|---|---|---|
| 0.0 | El 244.5 | |
| 27.0 | El 217.5 | Loose to compact, variable brown to grey slightly gravelly silty SAND |
| 30.0 | El 214.5 | Compact grey slightly silty SAND & GRAVEL |
| 39.2 | El 205.3 | Compact grey, slightly gravelly silty SAND<br>Top of Rock |
| 59.2 | El 185.3 | DOLOMITE, dk grey hard Few stringers of shale and few calcite crystals Occasional small broken zone. Rock unweathered |

Core recovery 98.5%

**D1105**

| Depth | Elevation | Description |
|---|---|---|
| 0.0 | El 252.0 | Loose greyish-brown, slightly gravelly silty SAND |
| 16.6 | El 235.4 | Loose, to fairly loose grey slightly silty SAND & GRAVEL Cobbles |
| 42.3 | El 209.7 | Top of Rock |
| 62.3 | El 189.7 | DOLOMITE, med. grey, hard Occasional stringers of calcite and shale Rock broken and slightly weathered |

Core recovery 95.5%

**D1106**

| Depth | Elevation | Description |
|---|---|---|
| 0.0 | El 250.2 | |
| 31.0 | El 219.2 | Apparently compact grey slightly sandy slightly gravelly SILT & CLAY |
| 45.4 | El 204.8 | Fairly compact grey slightly gravelly SAND & SILT |
| 54.0 | El 196.2 | Fairly soft slightly gravelly CLAY, SILT & SAND<br>Top of Rock |
| 74.0 | El 176.2 | LIMESTONE interbedded with dolomite and few stringers of shale Considerable calcite throughout Rock badly broken & slightly weathered throughout. |

Core recovery 85%

**D1107**

| Depth | Elevation | Description |
|---|---|---|
| 0.0 | El 253.3 | |
| 12.0 | El 241.3 | Compact brown silty slightly gravelly SAND |
| 28.5 | El 224.8 | Compact grey slightly gravelly SAND & SILT<br>Top of Rock |
| 49.1 | El 204.2 | LIMESTONE, dk grey few thin beds of dolomite Considerable calcite throughout Few small slightly weathered broken zones & seams |

Core recovery 99%

**D1108**

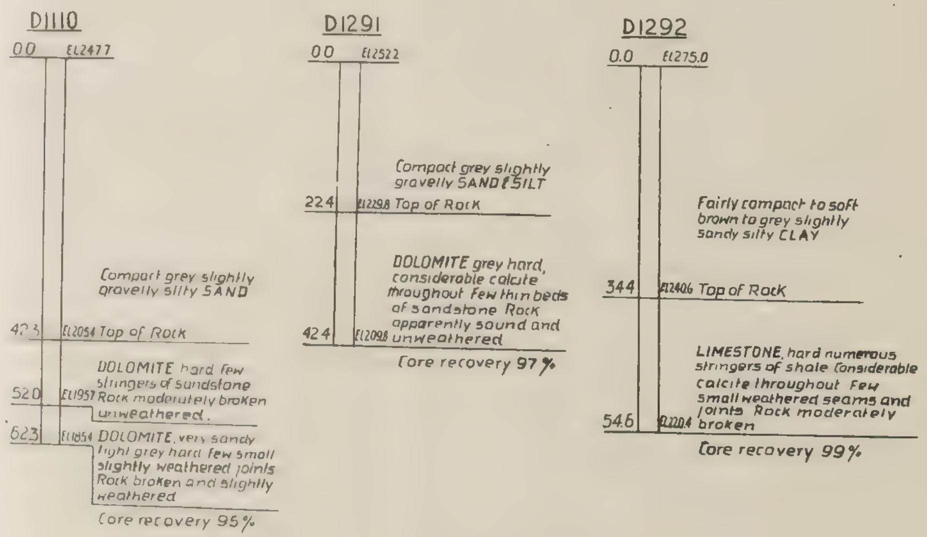
| Depth | Elevation | Description |
|---|---|---|
| 0.0 | El 260.0 | |
| 45.8 | El 214.2 | Apparently compact brown to grey slightly gravelly SAND & SILT All samples appear to be washed<br>Top of Rock |
| 65.8 | El 194.2 | LIMESTONE, hard occasional stringers of shale numerous calcite crystals. Numerous small slightly weathered seams Rock moderately broken |

Rock recovery 99.5%

**D1109**

| Depth | Elevation | Description |
|---|---|---|
| 0.0 | El 269.2 | |
| 12.0 | El 257.2 | Compact brown slightly gravelly silty SAND Occasional boulders |
| 25.0 | El 244.2 | Fairly loose brown slightly silty slightly gravelly SAND Few Cobbles and boulders |
| 35.5 | El 233.7 | Compact grey slightly gravelly silty SAND Occasional boulders |
| 36.4 | El 232.8 | Fairly loose brown, slightly gravelly, slightly silty fine to medium SAND |
| 47.5 | El 221.7 | Compact grey slightly gravelly silty SAND |
| 70.6 | El 198.6 | Fairly compact, brown-grey slightly silty, slightly gravelly SAND<br>Top of Rock |
| 80.1 | El 189.1 | DOLOMITE dk. grey hard Few stringers of shale and few large calcite crystals Rock broken but unweathered |

Core recovery 93.6%



**D1110**

| Depth | Elevation | Description |
|---|---|---|
| 0.0 | El 247.7 | |
| 42.3 | El 205.4 | Compact grey slightly gravelly silty SAND<br>Top of Rock |
| 52.0 | El 195.7 | DOLOMITE hard few stringers of sandstone Rock moderately broken unweathered. |
| 62.3 | El 185.4 | DOLOMITE, very sandy light grey hard few small slightly weathered joints Rock broken and slightly weathered |

Core recovery 95%

**D1291**

| Depth | Elevation | Description |
|---|---|---|
| 0.0 | El 252.2 | |
| 22.4 | El 229.8 | Compact grey slightly gravelly SAND & SILT<br>Top of Rock |
| 42.4 | El 209.8 | DOLOMITE grey hard, considerable calcite throughout Few thin beds of sandstone Rock apparently sound and unweathered |

Core recovery 97%

**D1292**

| Depth | Elevation | Description |
|---|---|---|
| 0.0 | El 275.0 | |
| 34.4 | El 240.6 | Fairly compact to soft brown to grey slightly sandy silty CLAY<br>Top of Rock |
| 54.6 | El 220.4 | LIMESTONE, hard numerous stringers of shale Considerable calcite throughout Few small weathered seams and joints Rock moderately broken |

Core recovery 99%

DESCRIPTIVE TERMS

Slightly silty, etc., denotes approximately 1% to 20% by dry weight of silt etc

Silty, etc., denotes approximately 20 to 40% by dry weight of silt, etc.

Silt & Sand, etc., denotes approximately 40% to 60 by dry wt. of silt, etc., except and Clay denotes more than 30% by dry wt. of Clay

NOTES

Analyses of overburden are based on dry samples.

Analyses of bedrock are based on 2⅛" cores obtained by drilling.

Elevations refer to M.S.L. datum, 1912 adjustment.

Holes numbered less than D1500 drilled with 3½" casing

TRANSVERSE MERCATOR COORDINATES

| HOLE No | NORTH | EAST |
|---|---|---|
| D1102 | 1742 412 | 231 238 |
| D1103 | 1742 968 | 230 857 |
| D1104 | 1744 093 | 230 092 |
| D1105 | 174[illegible] 751 | 229,544 |
| D1106 | 1742 131 | 225,447 |
| D1107 | 1741,009 | 224 098 |
| D1108 | 1740 573 | 222 870 |
| D1109 | [illegible] 160 | 221 063 |
| D1110 | 1738 299 | 220 [illegible]2 |
| D1291 | 1739 [illegible]25 | 222,046 |
| D1292 | 1739,834 | 223,939 |

ST LAWRENCE RIVER PROJECT
CHANNELS AND CUTS
VICINITY OF GALOP ISLAND
RECORD OF EXPLORATION

IN SHEETS SHEET NO. SCALE 1"-10'

U. S. ENGINEER OFFICE, MASSENA, NEW YORK DECEMBER 1941

SUBMITTED: R M Haines ENGINEER
RECOMMENDED: LT. COL., CORPS OF ENGINEERS
APPROVED: COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

DRAWN BY: K.H.
CHECKED BY: G.R.B.
FILE NO. GC-A-2/4
TRANSMITTED WITH LETTER OR ENDORSEMENT DATED ______ 194

PLATE 4

## ST. LAWRENCE RIVER

## PROBING RESULTS - GALOP ISLAND CHANNEL

| Probing No., Coordinates and Surface Elevation | Depth in Feet | Feet per Hour | Blows per Foot | Samples No. | Samples Depth | Description of Samples |
|---|---|---|---|---|---|---|
| **PB-4272** | | | | | | |
| N. 1,726,280 | 0-36 | Water | | | | |
| E. 205,189 | 36-37 | 720 | 5 | | | |
| El. 243.7 | 37-42 | 152 | 23 | | | |
| | 42-44 | 100 | 37 | | | |
| | 44-45 | 212 | 17 | | | |
| | 45-46 | 48 | 75 | | | |
| | 46-48 | 68 | 53 | | | |
| | 48-49 | 82 | 44 | | | |
| | 49-49.6 | 18 | 198 | | | |
| | Refusal | | | | | |
| **PB-4273** | | | | | | |
| N. 1,729,359 | 0-22 | Water | | | | |
| E. 209,648 | 22-25 | 720 | 5 | | | |
| El. 243.7 | 25-28 | 300 | 12 | | | |
| | 28-30 | 400 | 9 | | | |
| | 30-33 | 277 | 13 | | | |
| | 33-35 | 180 | 20 | | | |
| | 35-35.3 | 90 | 40 | | | |
| | Refusal | | | | | |
| **PB-4274** | | | | | | |
| N. 1,729,563 | 0-4 | Water | | S1 | 9.6 | SAND & SILT |
| E. 209,564 | 4-10 | 1200 | 3 | S2 | 26.6 | Silty SAND |
| El. 243.7 | 10-11 | 360 | 10 | | | |
| | 11-12 | 150 | 24 | | | |
| | 12-13 | 41 | 88 | | | |
| | 13-14 | 22 | 160 | | | |
| | 14-15 | 34 | 105 | | | |
| | 15-17 | 61 | 59 | | | |
| | 17-20 | 85 | 42 | | | |
| | 20-21 | 62 | 58 | | | |
| | 21-24 | 97 | 37 | | | |
| | 24-25 | 75 | 48 | | | |
| | 25-26 | 100 | 36 | | | |
| | 26-28 | 43 | 84 | | | |
| | 28-29 | 75 | 48 | | | |
| | 29-34 | 109 | 33 | | | |
| | 34-37 | 60 | 57 | | | |
| | 37-38 | 75 | 48 | | | |
| | 38-39 | 112 | 32 | | | |
| | 39-41 | 69 | 52 | | | |
| | 41-42 | 37 | 96 | | | |
| | 42-43 | 69 | 52 | | | |
| | 43-44 | 97 | 37 | | | |
| | 44-46 | 57 | 63 | | | |
| | 46-47 | 82 | 44 | | | |
| | 47-47.3 | 9 | 397 | | | |
| | Bottom of Hole | | | | | |
| **PB-4275** | | | | | | |
| N. 1,729,767 | 0-16.2 | Water | | S1 | 21.6 | Silty SAND |
| E. 209,479 | 16.2-19 | 900 | 4 | | | |
| El. 243.7 | 19-20 | 360 | 10 | | | |
| | 20-22 | 150 | 24 | | | |
| | 22-23 | 65 | 55 | | | |
| | 23-24 | 109 | 33 | | | |
| | 24-25 | 72 | 50 | | | |
| | 25-26 | 133 | 27 | | | |
| | 26-27 | 240 | 15 | | | |
| | 27-29 | 150 | 24 | | | |
| | 29-30 | 86 | 42 | | | |
| | 30-32 | 128 | 28 | | | |
| | 32-32.5 | 12 | 300 | | | |
| | Bottom of Hole | | | | | |
| **PB-4276** | | | | | | |
| N. 1,729,588 | 0-26 | Water | | | | |
| E. 210,202 | 26-27 | 900 | 4 | | | |
| El. 243.7 | 27-27.6 | 120 | 30 | | | |
| | Refusal | | | | | |
| **PB-4277** | | | | | | |
| N. 1,729,792 | 0-22.9 | Water | | | | |
| E. 210,188 | 22.9-24 | 227 | 13 | | | |
| El. 1.7,243.7 | 24-25 | 450 | 8 | | | |
| | 25-25.4 | 144 | 25 | | | |
| | Refusal | | | | | |
| **PB-4278** | | | | | | |
| N. 1,729,996 | 0-4 | Water | | S1 | 9.6 | Sandy SILT |
| E. 210,033 | 4-5 | 900 | 4 | S2 | 15.6 | Silty SAND |
| El. 243.7 | 5-6 | 450 | 8 | | | |
| | 6-13 | 860 | 4 | | | |
| | 13-15 | 450 | 8 | | | |
| | 15-17 | 900 | 4 | | | |
| | 17-20 | 450 | 8 | | | |
| | 20-27 | 225 | 16 | | | |
| | 27-29 | 144 | 25 | | | |
| | 29-30 | 94 | 38 | | | |
| | 30-30.2 | 6 | 550 | | | |
| | Bottom of Hole | | | | | |
| **PB-4279** | | | | | | |
| N. 1,729,818 | 0-28.7 | Water | | | | |
| E. 210,757 | 28.7-32 | 300 | 12 | | | |
| El. 243.7 | 32-33 | 189 | 19 | | | |
| | 33-33.3 | 180 | 20 | | | |
| | Refusal | | | | | |
| **PB-4280** | | | | | | |
| N. 1,730,022 | 0-24.2 | Water | | | | |
| E. 219,672 | 24.2-25 | 450 | 5 | | | |
| El. 1,7,243.7 | 25-29 | 210 | 17 | | | |
| | 29-29.6 | 180 | 20 | | | |
| | Refusal | | | | | |
| **PB-4281** | | | | | | |
| N. 1,730,226 | 0-27 | Water | | | | |
| E. 210,588 | 27-28 | 450 | 8 | | | |
| El. 1.7,243.7 | 28-29 | 257 | 14 | | | |
| | 29-31 | 157 | 23 | | | |
| | 31-32 | 120 | 30 | | | |
| | 32-32.5 | 180 | 20 | | | |
| | Refusal | | | | | |
| **PB-4282** | | | | | | |
| N. 1,730,047 | 0-6 | Water | | | | This area was used as a Dump when Canal was dredged. Many boulders on river bottom |
| E. 211,311 | 6-7 | 150 | 24 | | | |
| El. 243.7 | 7-8 | 103 | 35 | | | |
| | 8-9 | 86 | 42 | | | |
| | 9-9.3 | | | | | |
| | Bottom of Hole -Refusal at 8.8 on Second Attempt | | | | | |
| **PB-4283** | | | | | | |
| N. 1,760,251 | 0-8.8 | Water | | S1 | 16.6 | SILT & CLAY |
| E. 211,227 | 8.8-9 | 600 | 5 | | | |
| El. 243.7 | 9-10 | 171 | 21 | | | |
| | 10-11 | 90 | 40 | | | |
| | 11-16 | 106 | 34 | | | |
| | 16-16.9 | 90 | 40 | | | |
| | Refusal | | | | | |
| **PB-4284** | | | | | | |
| N. 1,730,455 | 0-13 | Water | | S1 | 16.6 | Sandy SILT Boulders on river bottom |
| E. 211,142 | 13-14 | 225 | 16 | | | |
| El. 243.7 | 14-16 | 120 | 30 | | | |
| | 16-19 | 164 | 22 | | | |
| | 19-20 | 116 | 31 | | | |
| | 20-21 | 73 | 49 | | | |
| | 21-23 | 81 | 45 | | | |
| | 23-24 | 57 | 63 | | | |
| | 24-24.3 | 43 | 83 | | | |
| | Refusal | | | | | |
| **PB-4285** | | | | | | |
| N. 1,730,161 | 0-4 | Water | | | | |
| E. 211,589 | 4-5 | 200 | 12 | | | |
| El. 243.7 | 5-6 | 51 | 71 | | | |
| | 6-7 | 74 | 48 | | | |
| | Bottom of Hole | | | | | |
| **PB-4285A** | | | | | | |
| El. 243.7 | 0-4 | Water | | | | |
| | 4-5 | 240 | 15 | | | |
| | 5-6 | 60 | 60 | | | |
| | 6-7 | 200 | 18 | | | |
| | 7-8 | 103 | 35 | | | |
| | 8-9 | 72 | 50 | | | |
| | 9-10 | 28 | 126 | | | |
| | 10-10.2 | 7 | 500 | | | |
| | Bottom of Hole | | | | | |
| **PB-4286** | | | | | | |
| N. 1,730,276 | 0-4 | Water | | | | |
| E. 211,866 | 4-5 | 210 | 17 | | | |
| El. 243.7 | 5-6 | 112 | 32 | | | |
| | 6-7 | 37 | 97 | | | |
| | 7-8 | 25 | 141 | | | |
| | Refusal | | | | | |
| **PB-4286A** | | | | | | |
| El. 243.7 | 0-4 | Water | | S1 | 9.6 | Silty SAND |
| | 4-5 | 156 | 23 | | | |
| | 5-9 | 200 | 18 | | | |
| | 9-10 | | 75 | | | |
| | 10-11 | 34 | 106 | | | |
| | 11-12 | 55 | 65 | | | |
| | 12-12.7 | 12.7 | 190 | | | |
| | Bottom of Hole | | | | | |
| **PB-4287** | | | | | | |
| N. 1,730,480 | 0-7 | Water | | S1 | 10.6 | Sandy SILT |
| E. 211,782 | 7-9 | 128 | 26 | | | |
| El. 243.7 | 9-10 | 82 | 44 | | | |
| | 10-11 | 128 | 28 | | | |
| | 11-12 | 88 | 41 | | | |
| | 12-13 | 44 | 82 | | | |
| | 13-15 | 90 | 40 | | | |
| | 15-15.1 | 2.4 | 1510 | | | |
| | Refusal | | | | | |
| **PB-4288** | | | | | | |
| N. 1,730,684 | 0-11 | Water | | S1 | 17.6 | Silty SAND |
| E. 211,696 | 11-12 | 1200 | 3 | | | |
| El. 243.7 | 12-15 | 400 | 9 | | | |
| | 15-16 | 327 | 11 | | | |
| | 16-20 | 144 | 25 | | | |
| | 20-22 | 100 | 36 | | | |
| | 22-23 | 69 | 52 | | | |
| | 23-24 | 32 | 111 | | | |
| | 24-25 | 23 | 158 | | | |
| | 25-25.5 | 11.6 | 310 | | | |
| | Refusal | | | | | |

FILE NO. GC-A-2/5

PLATE-5

## ST LAWRENCE RIVER

## PROBING RESULTS - GALOP ISLAND CHANNEL

| Probing No. Coordinates and Surface Elevation | Depth in Feet | Feet per Hour | Blows per Foot | Samples No. | Samples Depth | Description of Samples |
|---|---|---|---|---|---|---|
| PR-4289 | | | | | | |
| N. 1,730,505 | 0-9 | Water | | | | Many boulders |
| E. 212,420 | 9-11 | 257 | 5 | | | on river bottom |
| El. 243.7 | 11-12 | 106 | 34 | | | |
| | 12-12.2 | 40 | 90 | | | |
| | Refusal at 12.2 on two attempts | | | | | |
| PR-4290 | | | | | | |
| N. 1,730,709 | 0-12.7 | Water | | | | Boulders on |
| E. 212,336 | 12.7-13 | 300 | 12 | | | river bottom |
| El. 243.7 | 13-14 | 144 | 25 | | | |
| | 14-14.8 | [illegible] | 40 | | | |
| | Refusal on 3 attempts | | | | | |
| PR-4291 | | | | | | |
| N. 1,730,913 | 0-13 | Water | | | | Many large |
| E. 212,251 | 13-14 | 450 | 8 | | | boulders on |
| El. 243.7 | 14-15 | 103 | 35 | | | river bottom |
| | Refusal on three attempts | | | | | |
| PR-4292 | | | | | | |
| N. 1,730,735 | 0-24.5 | Water | | | | Cobbles & Boulders |
| E. 212,975 | 24.5-25 | 360 | 10 | | | on river bottom |
| El. 243.6 | 25-26 | 200 | 18 | | | |
| | Refusal on three attempts | | | | | |
| PR-4293 | | | | | | |
| N. 1,730,939 | 0-24.4 | Water | | | | Boulders on |
| E. 212,891 | 24.4-25 | 360 | 10 | | | river bottom |
| El. 243.6 | 25-25.3 | 97 | 37 | | | |
| | Refusal on two attempts | | | | | |
| PR-4294 | | | | | | |
| N. 1,731,173 | 0-22 | Water | | | | Many stones on |
| E. 212,788 | 22-23 | 156 | 23 | | | river bottom |
| El. 243.6 | 23-23.1 | 45 | 80 | | | |
| | Refusal on three attempts | | | | | |
| PR-4295 | | | | | | |
| N. 1,731,053 | 0-36.5 | Water | | | | |
| E. 213,168 | | | | | | |
| El. 243.6 | | | | | | |
| PR-4296 | | | | | | |
| N. 1,731,353 | 0-34.5 | Water | | | | |
| E. 213,128 | 34.5-37 | 1800 | 2 | | | |
| El. 243.6 | 37-38 | 450 | 8 | | | |
| | 38-41 | 327 | 11 | | | |
| | 41-42 | 156 | 23 | | | |
| | 42-43 | 47 | 76 | | | |
| | 43-44 | 75 | 48 | | | |
| | 44-46 | 120 | 30 | | | |
| | 46-47 | 75 | 48 | | | |
| | Bottom of Hole | | | | | |
| PR-4297 | | | | | | |
| N. 1,731,652 | 0-32 | Water | | | | |
| E. 713,428 | 32-35 | 240 | 15 | | | |
| El. 243.6 | 35-36 | 360 | 10 | | | |
| | 36-37 | 112 | 32 | | | |
| | 37-37.8 | 16 | 215 | | | |
| | Refusal | | | | | |
| PR-4298 | | | | | | |
| N. 1,730,391 | 0-5.6 | Water | | | | Cobbles & boulders |
| E. 212,143 | 5.6-6 | 360 | 10 | | | on river bottom |
| El. 243.7 | 6-6 | 82 | 44 | | | |
| | 6-7 | 57 | 63 | | | |
| | 7-10 | 42 | 86 | | | |
| | 10-11 | 61 | 59 | | | |
| | 11-11.4 | 39 | 92 | | | |
| | Refusal at 6.8 on three attempts | | | | | |
| PR-4299 | | | | | | |
| N. 1,735,844 | 0-4.6 | Water | | S1 | 10.6 | Silty SAND |
| E. 217,933 | 4.6-6 | 65 | 55 | | | Many boulders |
| El. 243.3 | 6-7 | 150 | 24 | | | on river bottom |
| | 7-10 | 112 | 32 | | | |
| | 10-11 | 133 | 27 | | | |
| | 11-11.8 | 90 | 40 | | | |
| | Refusal on three attempts | | | | | |
| PR-4300 | | | | | | |
| N. 1,736,007 | 0-31 | Water | | | | |
| E. 217,743 | 31-33 | 720 | 5 | | | |
| El. 243.3 | Below Grade | | | | | |
| PR-4301 | | | | | | |
| N. 1,736,071 | 0-1 | [illegible] | [illegible] | | | |
| E. 218,128 | 1-2 | 70 | 51 | | | |
| El. 243.3 | 2-3 | 82 | 44 | | | |
| | 3-4 | 63 | 57 | | | |
| | 4-5.8 | 40 | 90 | | | |
| | Refusal on three attempts | | | | | |
| PR-4302 | | | | | | |
| N. 1,736,235 | 0-4.3 | Water | | | | Many boulders on |
| E. 217,938 | 4.3-5 | 138 | 26 | | | river bottom |
| El. 243.3 | 5-6 | 60 | 60 | | | |
| | 6-7 | 49 | 73 | | | |
| | 7-7.6 | 40 | 90 | | | |
| | Refusal at 8.6 on three attempts | | | | | |
| PR-4303 | | | | | | |
| N. 1,736,397 | 0-25.7 | Water | | | | |
| E. 217,748 | 25.7-27 | 3600 | 0 | | | |
| El. 243.3 | 27-28 | 92 | 39 | | | |
| | 28-28.9 | 35 | 103 | | | |
| | Refusal | | | | | |
| PR-4304 | | | | | | |
| N. 1,736,300 | 0-5 | Water | | S1 | 10.6 | SILT & CLAY |
| E. 218,323 | 5-11 | 144 | 25 | | | No stones on |
| El. 243.3 | 11-13 | 116 | 31 | | | river bottom |
| | 13-14 | 82 | 44 | | | |
| | 14-15 | 38 | 94 | | | |
| | 15-17 | 44 | 81 | | | |
| | 17-18 | 58 | 62 | | | |
| | 18-18.3 | 16 | 220 | | | |
| | Refusal | | | | | |
| PR-4305 | | | | | | |
| N. 1,736,497 | 0-3.3 | Water | | | | |
| E. 218,170 | 3.3-4 | 600 | 6 | | | |
| El. 242.8 | 4-5 | 1200 | 3 | | | |
| | 5-6 | 109 | 33 | | | |
| | 6-7 | 51 | 70 | | | |
| | 7-8 | 69 | 52 | | | |
| | 8-10 | 25 | 146 | | | |
| | 10-11 | 19 | 162 | | | |
| | 11-12 | 17 | 204 | | | |
| | Bottom of Hole -No Refusal | | | | | |
| PR-4306 | | | | | | |
| N. 1,736,625 | 0-12 | Water | | S1 | 17.6 | SAND & SILT |
| E. 217,943 | 12-13 | 150 | 24 | | | In this area a very |
| El. 243.3 | 13-14 | 120 | 30 | | | large number of loads |
| | 14-15 | 144 | 25 | | | of boulders & broken |
| | 15-16 | 257 | 14 | | | limestone slabs have |
| | 16-17 | 120 | 30 | | | been dumped from |
| | 17-17.6 | 108 | 33 | | | barges. |
| | Refusal on boulder | | | | | |
| PR-4307 | | | | | | |
| N. 1,736,528 | 0-3 | Water | | | | |
| E. 218,518 | 3-4 | 3600 | 1 | | | |
| El. 242.7 | 4-5 | 600 | 6 | | | |
| | 5-6 | 144 | 25 | | | |
| | 6-7 | 94 | 38 | | | |
| | 7-8 | 67 | 54 | | | |
| | 8-10 | 57 | 63 | | | |
| | 10-12 | 44 | 81 | | | |
| | 12-13 | 35 | 101 | | | |
| | 13-14 | 25 | 140 | | | |
| | 14-14.5 | 10.6 | 340 | | | |
| | Bottom of Hole-No Refusal | | | | | |
| PR-4308 | | | | | | |
| N. 1,736,691 | 0-3.9 | Water | | S1 | 16.6 | SILT & CLAY |
| E. 218,328 | 3.9-7.2 | 3600 | 0 | S2 | 23.6 | Silty CLAY |
| El. 243.7 | 7.2-8 | 900 | 4 | S3 | 30.6 | Silty CLAY |
| | 8-9 | 400 | 5 | | | |
| | 9-10 | 245 | 16 | | | |
| | 10-11 | 133 | 27 | | | |
| | 11-15 | 116 | 34 | | | |
| | 15-27 | 110 | 33 | | | |
| | 27-30 | 90 | 40 | | | |
| | 30-31 | 60 | 60 | | | |
| | 31-33 | 78 | 46 | | | |
| | 33-34 | 60 | 60 | | | |
| | 34-34.7 | 66 | 54 | | | |
| | Bed Rock -Refusal | | | | | |
| PR-4309 | | | | | | |
| N. 1,736,853 | 0-6 | Water | | S1 | 10.6 | Sandy SILT |
| E. 218,138 | 6-12 | 3600 | 1 | S2 | 15.6 | SILT & CLAY |
| El. 242.8 | 12-14 | 1200 | 3 | | | |
| | 14-16 | 515 | 7 | | | |
| | 16-24 | 200 | 18 | | | |
| | 24-25 | 133 | 27 | | | |
| | 25-26 | 30 | 119 | | | |
| | 26-27 | 16 | 218 | | | |
| | Bottom of Hole -No Refusal | | | | | |
| PR-4310 | | | | | | |
| N. 1,736,955 | 0-4 | Water | | S1 | 10.6 | SILT & CLAY |
| E. 218,944 | 4-7 | 3600 | 0 | S2 | 16.6 | SILT & CLAY |
| El. 242.7 | 7-16 | 171 | 21 | S3 | 21.6 | SILT & CLAY |
| | 16-25 | 122 | 30 | | | |
| | 25-27 | 45 | [illegible] | | | |
| | 27-27.8 | 37 | 97 | | | |
| | Bottom of Hole -No Refusal | | | | | |
| PR-4311 | | | | | | |
| N. 1,737,147 | 0-4 | Water | | S1 | 9.6 | SILT & CLAY |
| E. 218,718 | 4-9 | 3600 | 0 | S2 | 15.6 | Silty CLAY |
| El. 242.7 | 9-9.6 | 720 | 5 | S3 | 20.6 | SILT & CLAY |
| | 9.6-12 | 560 | 7 | S4 | 25.6 | Sandy SILT |
| | 12-14 | 180 | 20 | | | |
| | 14-25 | 133 | 27 | | | |
| | 25-27 | 88 | 41 | | | |
| | 27-28 | [illegible] | 30 | | | |
| | 28-28.8 | 22 | 160 | | | |
| | Bottom of Hole -No Refusal | | | | | |

FILE NO GC-A-2/6
PLATE-6

# ST LAWRENCE RIVER

## PROBING RESULTS - GALOP ISLAND CHANNEL

| Probing No. Coordinates and Surface Elevation | Depth in Feet | Feet per Hour | Blows per Feet | Samples No. | Samples Depth | Description of Samples |
|---|---|---|---|---|---|---|
| PB-4312 | | | | | | |
| N. 1,737,809 | 0-5.7 | Water | | S1 | 17.6 | Silty CLAY |
| E. 218,529 | 5.7-9.7 | 3600 | 0 | S2 | 23.6 | Silty CLAY |
| EL. 242.7 | 9.7-12 | 338 | 11 | | | |
| | 12-14 | 212 | 17 | | | |
| | 14-17 | 163 | 22 | | | |
| | 17-18 | 120 | 30 | | | |
| | 18-23 | 150 | 24 | | | |
| | 23-28 | 116 | 31 | | | |
| | 28-30 | 92 | 39 | | | |
| | 30-32 | 100 | 36 | | | |
| | 32-33 | 90 | 40 | | | |
| | Refusal | | | | | |
| PB-4313 | | | | | | |
| N. 1,737,362 | 0-5 | Water | | S1 | 10.6 | SAND |
| E. 219,390 | 5-7 | 900 | 4 | | | |
| EL. 242.7 | 7-8 | 360 | 10 | | | |
| | 8-9 | 53 | 67 | | | |
| | 9-11 | 75 | 48 | | | |
| | 11-13 | 105 | 35 | | | |
| | 13-14 | 51 | 70 | | | |
| | 14-14.4 | 9 | 400 | | | |
| | Bottom of Hole - No Refusal | | | | | |
| PB-4314 | | | | | | |
| N. 1,737,602 | 0-4 | Water | | S1 | 10.6 | SILT & CLAY |
| E. 219,109 | 4-6 | 3600 | 0 | S2 | 15.6 | SILT & CLAY |
| EL. 242.7 | 6-8 | 240 | 15 | S3 | 20.6 | SILT & CLAY |
| | 8-9 | 150 | 24 | S4 | 25.6 | Silty CLAY |
| | 9-15 | 102 | 35 | S5 | 31.6 | Sandy SILT & CLAY |
| | 15-16 | 82 | 44 | | | |
| | 16-27 | 81 | 44 | | | |
| | 27-31 | 103 | 35 | | | |
| | 31-32 | 72 | 50 | | | |
| | 32-33 | 34 | 106 | | | |
| | 33-34 | 55 | 65 | | | |
| | 34-35 | 27 | 130 | | | |
| | Refusal | | | | | |
| PB-4315 | | | | | | |
| N. 1,737,765 | 0-4.4 | Water | | S1 | 16.6 | SILT & CLAY |
| E. 218,919 | 4.4-9 | 3600 | 0 | S2 | 23.6 | Silty CLAY |
| EL. 242.7 | 9-11 | 328 | 11 | | | |
| | 11-14 | 189 | 19 | | | |
| | 14-16 | 150 | 24 | | | |
| | 16-17 | 92 | 39 | | | |
| | [illegible] | 120 | 30 | | | |
| | 29-31 | 49 | 73 | | | |
| | 31-31.2 | 103 | 35 | | | |
| | Refusal | | | | | |
| PB-4316 | | | | | | |
| N. 1,737,708 | 0-8.5 | Water | | S1 | 10.6 | SAND |
| E. 219,769 | 8.5-11 | 112 | 32 | | | |
| EL. 242.7 | 11-12 | 76 | 47 | | | |
| | 12-12.3 | 15 | 240 | | | |
| | Bottom of Hole - No Refusal | | | | | |
| PB-4317 | | | | | | |
| N. 1,737,955 | 0-5 | Water | | | | |
| E. 219,594 | 5-7 | 450 | 8 | | | |
| EL. 242.4 | 7-8 | 112 | 32 | | | |
| | 8-9 | 45 | 80 | | | |
| | 9-10 | 16 | 220 | | | |
| | Bottom of Hole - No Refusal | | | | | |
| PB-4318 | | | | | | |
| N. 1,738,159 | 0-4.7 | Water | | S1 | 10.6 | SAND |
| E. 219,4[illegible] | 4.7-6 | 103 | 35 | | | |
| EL. 242.7 | 6-7 | 225 | 16 | | | |
| | 7-8 | 600 | 6 | | | |
| | 8-9 | 72 | 50 | | | |
| | 9-10 | 44 | 82 | | | |
| | 10-11 | 28 | 126 | | | |
| | 11-11.4 | 42 | 85 | | | |
| | Refusal | | | | | |
| PB-4319 | | | | | | |
| N. 1,738,098 | 0-3 | 1200 | 3 | | | |
| E. 220,228 | 3-4 | 133 | 27 | | | |
| EL. 246.0 | 4-5 | 62 | 58 | | | |
| | 5-5.8 | 11.6 | 311 | | | |
| | Bottom of Hole - No Refusal | | | | | |
| PB-4320 | | | | | | |
| N. 1,738,302 | 0-1 | 277 | 13 | | | Scattered brush numerous boulders on surface |
| E. 220,083 | 1-3 | 120 | 30 | | | |
| EL. 256.2 | 3-5 | 85 | 25 | | | |
| | 5-6 | 51 | 70 | | | |
| | 6-7 | 32 | 113 | | | |
| | 7-8 | 14 | 243 | | | |
| | Bottom of Hole - No Refusal | | | | | |
| PB-4321 | | | | | | |
| N. 1,738,506 | 0-1 | 600 | 6 | | | Many boulders on surface on this area |
| E. 219,938 | 1-2 | 171 | 21 | | | |
| EL. 258.7 | 2-3 | 62 | 58 | | | |
| | 3-4 | 29 | 121 | | | |
| | 4-5 | 25 | 140 | | | |
| | 5-6 | 21 | 171 | | | |
| | 6-6.4 | 8.9 | 405 | | | |
| | Bottom of Hole - | | | | | |

| Probing No. Coordinates and Surface Elevation | Depth in Feet | Blows per Feet | Feet per hour | Samples No. | Samples Depth | Description of Samples |
|---|---|---|---|---|---|---|
| PB-4322 | | | | | | |
| N. 1,738,446 | 0-1 | 6 | 600 | | | |
| E. 220,717 | 1-2 | 26 | 138 | | | |
| EL. 257.4 | 2-3 | 76 | 47 | | | |
| | 3-4 | 43 | 84 | | | |
| | 4-5 | 66 | 54 | | | |
| | 5-6 | 116 | 31 | | | |
| | 6-8 | 150 | 24 | | | |
| | 8-10 | 173 | 20 | | | |
| | 10-11 | 188 | 19 | | | |
| | 11-12 | 81 | 44 | | | |
| | 12-13 | 67 | 53 | | | |
| | 13-13.6 | 420 | 8 | | | |
| | Bottom of Hole - No Refusal | | | | | |
| PB-4323 | | | | | | |
| N. 1,738,649 | 0-1 | 4 | 900 | | | Many boulders on surface in this area |
| E. 220,572 | 1-2 | 19 | 190 | | | |
| EL. 258.8 | 2-4 | 43 | 84 | | | |
| | 4-5 | 48 | 75 | | | |
| | Refusal on three atempts | | | | | |
| PB-4324 | | | | | | |
| N. 1,738,853 | 0-1 | 6 | 600 | | | A few large boulders on surface in this area |
| E. 220,428 | 1-2 | 23 | 156 | | | |
| EL. 256.6 | 2-5 | 105 | 34 | | | |
| | 5-5.4 | 500 | 7.2 | | | |
| | Bottom of Hole - | | | | | |
| PB-4325 | | | | | | |
| N. 1,738,793 | 0-1 | 7 | 520 | S1 | 7.6 | Sandy SILT |
| E. 221,206 | 1-3 | 17 | 212 | | | |
| EL. 260.6 | 3-4 | 24 | 150 | | | |
| | 4-7 | 30 | 120 | | | |
| | 7-8 | 39 | 92 | | | |
| | 8-10 | 69 | 52 | | | |
| | 10-10.4 | 170 | 21 | | | |
| | Refusal | | | | | |
| PB-4326 | | | | | | |
| N. 1,738,997 | 0-1 | 8 | 450 | | | Some large boulders on surface in this area |
| E. 221,062 | 1-2 | 13 | 277 | | | |
| EL. 259.1 | 2-3 | 33 | 109 | | | |
| | 3-4 | 131 | 27 | | | |
| | 4-5 | 82 | 44 | | | |
| | 5-5.2 | 500 | 7.2 | | | |
| | Bottom of Hole - | | | | | |
| PB-4327 | | | | | | |
| N. 1,739,201 | 0-1 | 7 | 515 | | | Some boulders on surface in this area |
| E. 220,917 | 1-2 | 26 | 138 | | | |
| EL. 261.7 | 2-3 | 67 | 53 | | | |
| | 3-4 | 104 | 34 | | | |
| | 4-5 | 222 | 16 | | | |
| | Bottom of Hole - No Refusal | | | | | |
| PB-4328 | | | | | | |
| N. 1,739,140 | 0-2 | 6 | 600 | S1 | 7.6 | Silty SAND |
| E. 221,696 | 2-3 | 30 | 120 | | | |
| EL. 259.1 | 3-5 | 41 | 88 | | | |
| | 5-7 | 28 | 128 | | | |
| | 7-8 | 75 | 48 | | | |
| | 8-9 | 89 | 40 | | | |
| | 9-10 | 175 | 20 | | | |
| | 10-10.8 | 310 | 11.6 | | | |
| | Bottom of Hole - No Refusal | | | | | |
| PB-4329 | | | | | | |
| N. 1,739,344 | 0-1 | 7 | 515 | | | Boulders on surface in this area up to 6' in dia. |
| E. 221,551 | 1-3 | 21 | 171 | | | |
| EL. 265.3 | 3-4 | 37 | 97 | | | |
| | 4-4.8 | 260 | 13.8 | | | |
| | Refusal at 4.8 on two attempts | | | | | |
| PB-4330 | | | | | | |
| N. 1,739,548 | 0-1 | 9 | 400 | | | |
| E. 221,406 | 1-3 | 22 | 163 | | | |
| EL. 266.1 | 3-4 | 75 | 48 | | | |
| | 4-5 | 107 | 33 | | | |
| | 5-5.8 | 260 | 13.8 | | | |
| | Bottom of Hole | | | | | |
| PB-4331 | | | | | | |
| N. 1,739,488 | 0-1 | 9 | 400 | | | |
| E. 222,185 | 1-3 | 32 | 112 | | | |
| EL. 250.7 | 3-4 | 114 | 31 | | | |
| | 4-4.4 | 625 | 5.7 | | | |
| | No Refusal | | | | | |
| PB-4332 | | | | | | |
| N. 1,739,691 | 1-2 | 8 | 450 | S1 | 7.6 | Silty SAND |
| E. 222,[illegible] | 2-3 | 17 | 212 | | | |
| EL. 240.6 | 3-4 | 83 | 43 | | | |
| | 4-6 | 58 | 62 | | | |
| | 6-7 | 65 | 55 | | | |
| | 7-7.6 | 400 | [illegible] | | | |

FILE NO GC-A-2/7
PLATE-7

# ST LAWRENCE RIVER

## PROBING RESULTS - GALOP ISLAND CHANNEL

| Probing No. Coordinates and Surface Elevation | Depth in Feet | Blows per Foot | Feet per Hour | Samples No. | Samples Depth | Description of Samples |
|---|---|---|---|---|---|---|
| PB-4333 | | | | | | |
| N. 1,739,878 | 0-2 | 2 | 1800 | S1 | 7.6 | SAND |
| E. 221,871 | 2-3 | 22 | 163 | | | Many cobbles & |
| EL. 236.8 | 3-4 | 56 | 64 | | | boulders on surface |
| | 4-5 | 90 | 40 | | | in this area |
| | 5-6 | 42 | 86 | | | |
| | 6-7 | 66 | 54 | | | |
| | 7-8 | 111 | 32 | | | |
| | 8-8.5 | 400 | 9 | | | |
| | No Refusal | | | | | |
| PB-4334 | | | | | | |
| N. 1,739,835 | 0-2 | 2 | 1800 | S1 | 7.6 | SAND |
| E. 222,674 | 2-4 | 20 | 180 | | | |
| EL. 238.1 | 4-6 | 10 | 360 | | | |
| | 6-7 | 20 | 180 | | | |
| | 7-11 | 31 | 116 | | | |
| | 11-12 | 45 | 80 | | | |
| | 12-13 | 77 | 47 | | | |
| | 13-14 | 38 | 95 | | | |
| | 14-14.9 | 290 | 12.4 | | | |
| | No Refusal | | | | | |
| PB-4335 | | | | | | |
| N. 1,740,039 | 0-10 | Water | | | | |
| E. 222,529 | 10-12 | 0 | 3600 | | | |
| EL. 236.6 | 12-15 | 6 | 600 | | | |
| | 15-18 | 13 | 277 | | | |
| | 17-18 | 32 | 112 | | | |
| | 18-18.9 | 290 | 12.4 | | | |
| | No Refusal | | | | | |
| PB-4336 | | | | | | |
| N. 1,740,243 | 0-13 | Water | | | | |
| E. 222,385 | 13-15 | 15 | 240 | | | |
| EL. 236.6 | 15-15.4 | 600 | 6 | | | |
| | Refusal | | | | | |
| PB-4337 | | | | | | |
| N. 1,740,088 | 0-1 | 5 | 720 | | | |
| E. 222,919 | 1-2 | 19 | 189 | | | |
| EL. 273.8 | 2-3 | 105 | 34 | | | |
| | Refusal on five attempts | | | | | |
| PB-4338 | | | | | | |
| N. 1,740,416 | 0-11 | Water | 515 | | | |
| E. 222,629 | 11-13 | 110 | 385 | | | |
| EL. 236.6 | 13-14 | 120 | 38 | | | |
| | 14-15 | 125 | 29 | | | |
| | 15-16 | 230 | 15.6 | | | |
| | No Refusal | | | | | |
| PB-4339 | | | | | | |
| N. 1,740,211 | 0-2 | 2 | 1800 | | | Many boulders & |
| E. 223.204 | 2-3 | 4 | 900 | | | cobbles on surface |
| EL. 238.5 | 3-5 | 23 | 156 | | | in this area |
| | 5-6 | 68 | 53 | | | |
| | 6-7 | 107 | 33 | | | |
| | 7-8 | 220 | 16 | | | |
| | Bottom of Hole | | | | | |
| PB-4340 | | | | | | |
| N. 1,740,415 | 0-2 | 4 | 900 | S1 | 7.6 | Silty SAND |
| E. 223,059 | 2-3 | 17 | 212 | | | |
| EL. 244.3 | 3-4 | 51 | 71 | | | Many boulders in |
| | 4-5 | 23 | 156 | | | this area |
| | 5-7 | 107 | 33 | | | |
| | 7-8 | 195 | 18 | | | |
| | 8-8.5 | 408 | 8.8 | | | |
| | Bottom of Hole | | | | | |
| PB-4341 | | | | | | |
| N. 1,740,619 | 0-1 | 2 | 1800 | | | |
| E. 222,915 | 1-2 | 5 | 720 | | | |
| EL. 260.3 | 2-3 | 90 | 40 | | | |
| | 3-3.9 | 280 | 12.8 | | | |
| | No Refusal | | | | | |
| PB-4342 | | | | | | |
| N. 1,740,385 | 0-6 | Water | | | | |
| E. 223,449 | 6-7 | 4 | 900 | | | |
| EL. 235.1 | 7-10.9 | 13 | 283 | | | |
| | Refusal | | | | | |
| PB-4343 | | | | | | |
| N. 1,749,589 | 0-5 | Water | | | | |
| E. 223,304 | 5-6 | 1 | 3600 | | | |
| EL. 235.1 | 6-7 | 8 | 450 | | | |
| | 7-9 | 12 | 300 | | | |
| | 9-11 | 19 | 189 | | | |
| | 11-12 | 42 | 86 | | | |
| | 12-14 | 24 | 150 | | | |
| | 14-15 | 60 | 60 | | | |
| | 15-15.8 | 90 | 40 | | | |
| | Refusal | | | | | |
| PB-4344 | | | | | | |
| N. 1,740,792 | 0-12 | Water | | | | |
| E. 223,159 | 12-13 | 1 | 3600 | | | |
| EL. 235.1 | 13-14 | 5 | 720 | | | |
| | 14-15 | 102 | 35 | | | |
| | 15-16 | 187 | 19 | | | |
| | 16-16.7 | 360 | 10 | | | |
| | No Refusal | | | | | |
| PB-4345 | | | | | | |
| N. 1,749,732 | 0-3 | 6 | 617 | | | Many cobbles & |
| E. 223,938 | 3-4 | 21 | 171 | | | boulders on surface |
| EL. 237.0 | 4-5 | 12 | 300 | | | in this area |
| | 5-5.6 | 16 | 225 | | | |
| | Bed Rock-Refusal | | | | | |
| PB-4346 | | | | | | |
| N. 1,740,936 | 0-7 | Water | | | | |
| E. 223,793 | 7-8 | 0 | 3600 | | | |
| EL. 234.9 | 8-12 | 4 | 900 | | | |
| | 12-13 | 20 | 180 | | | |
| | 13-15 | 34 | 106 | | | |
| | 15-16 | 61 | 59 | | | |
| | 16-18 | 54 | 67 | | | |
| | 18-18.6 | 60 | 60 | | | |
| | Refusal | | | | | |
| PB-4347 | | | | | | |
| N. 1,741,140 | 0-16 | Water | | | | |
| E. 223,649 | 16-18 | 5 | 720 | | | |
| EL. 235.1 | 18-20 | 70 | 51 | | | |
| | 20-21 | 175 | 20 | | | |
| | 21-22 | 197 | 18 | | | |
| | 22-22.4 | 515 | 7 | | | |
| | No Refusal | | | | | |
| PB4348 | | | | | | |
| N. 1,740,906 | 0-1 | 5 | 720 | | | |
| E. 224,183 | 1-3 | 25 | | | | |
| EL. 258.8 | Bottom of Hole -Refusal on four attempts | | | | | |
| PB-4349 | | | | | | |
| N. 1,741,313 | 0-10 | Water | | | | |
| E. 223,893 | 10-12 | 28 | 128 | | | |
| EL. 234.9 | 12-13 | 129 | 27 | | | |
| | 13-14 | 225 | 16 | | | |
| | 14-14.9 | 280 | 12.8 | | | |
| | No Refusal | | | | | |
| PB-4350 | | | | | | |
| N. 1,741,065 | 0-1 | 3 | 1200 | | | |
| E. 224,407 | 1-3 | 6 | 600 | | | |
| EL. 237.0 | 3-4 | 11 | 328 | | | |
| | 4-4.8 | 20 | 180 | | | |
| | Refusal on three attempts | | | | | |
| PB-4351 | | | | | | |
| N. 1,741,283 | 0-1 | 8 | 450 | | | A few large trees |
| E. 224,283 | 1-2 | 21 | 171 | | | & boulders in this |
| EL. 249.4 | 2-3 | 59 | 61 | | | area |
| | 3-4 | 136 | 26 | | | |
| | 4-4.5 | 412 | 8.7 | | | |
| | No Refusal | | | | | |
| PB-4352 | | | | | | |
| N. 1,741,487 | 0-9 | Water | | | | |
| E. 224,138 | 9-10 | 0 | 3600 | | | |
| EL. 234.9 | 10-15 | 3 | 1200 | | | |
| | 15-18 | 10 | 360 | | | |
| | 18-19 | 69 | 52 | | | |
| | 19-20 | 86 | 42 | | | |
| | 20-21 | 160 | 22 | | | |
| | 21-21.8 | 310 | 11.6 | | | |
| | No Refusal | | | | | |
| PB-4353 | | | | | | |
| N. 1,741,427 | 0-9 | Water | | | | |
| E. 224,917 | Refusal on three attempts | | | | | |
| EL. 236.3 | | | | | | |
| PB-4354 | | | | | | |
| N. 1,741,631 | 0-10 | Water | | S1 | 21.6 | SILT & CLAY |
| E. 224,772 | 10-16 | 0 | 3600 | | | |
| EL. 236.3 | 16-21 | 8 | 450 | | | |
| | 21-23 | 45 | 80 | | | |
| | Refusal | | | | | |
| PB-4355 | | | | | | |
| N. 1,741,834 | 0-8 | Water | | S1 | 21.6 | Silty CLAY |
| E. 224,627 | 8-15 | 0 | 3600 | S2 | 26.6 | SILT & CLAY |
| EL. 236.3 | 15-21 | 4 | 900 | S3 | 32.6 | SILT & CLAY |
| | 21-28 | 12 | 300 | S4 | 37.6 | SAND |
| | 28-31 | 22 | 163 | | | |
| | 31-32 | 15 | 240 | | | |
| | 32-34 | 26 | 138 | | | |
| | 34-38 | 30 | 120 | | | |
| | 38-38.7 | 60 | 60 | | | |
| | Refusal | | | | | |
| PB-4356 | | | | | | |
| N. 1,741,600 | 0-1 | 5 | 720 | | | |
| E. 225,161 | 1-2 | 22 | 163 | | | |
| EL 252.2 | 2-3 | 42 | 85 | | | |
| | 3-5 | 52 | 69 | | | |
| | 5-6 | 91 | 39 | | | |
| | 6-7 | 167 | 21 | | | |
| | 7-8 | 215 | 16.7 | | | |
| | Bottom of Hole | | | | | |

FILE NO. GC-A-2/8
PLATE-8

## ST. LAWRENCE RIVER

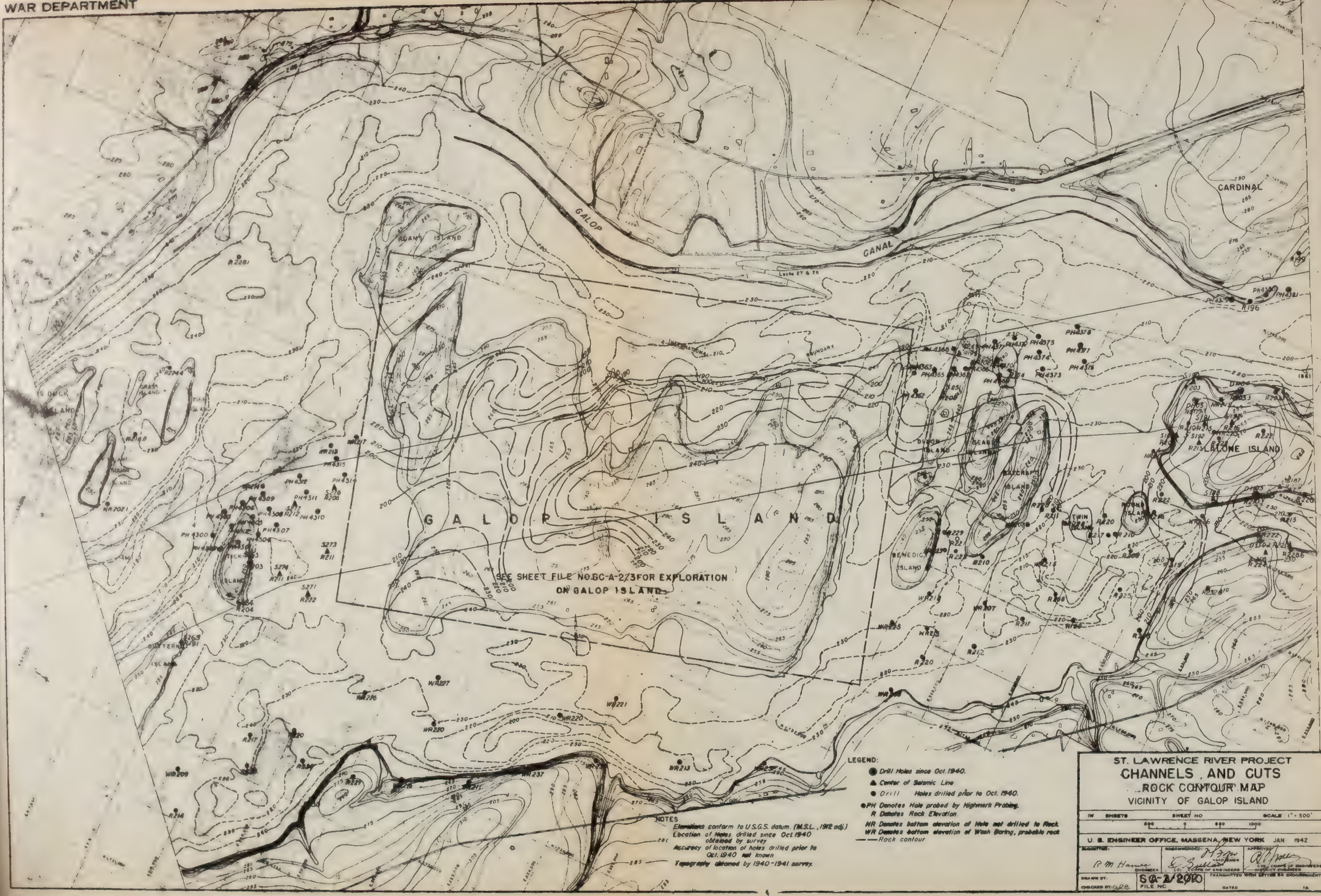
## PROBING RESULTS - GALOP ISLAND CHANNEL

| Probing No. and Coordinates and Surface Elevation | Depth in Feet | Blows per Foot | Feet per Hour | Samples No. | Samples Depth | Description of Samples |
|---|---|---|---|---|---|---|
| PH-4357 | | | | | | |
| N. 1,742,804 | 0-7.5 | Water | | | | |
| E. 225,017 | 7.5-9.9 | 0 | 3600 | S1 | 15.6 | SAND |
| EL. 237.0 | 9.9-12 | 10 | 360 | | | |
| | 12-15 | 7 | 515 | | | |
| | 15-16 | 17 | 212 | | | |
| | 16-18 | 49 | 74 | | | |
| | 18-19 | 85 | 42 | | | |
| | 19-20 | 132 | 27 | | | |
| | 20-20.3 | 190 | 18.9 | | | |
| | Refusal | | | | | |
| PH-4358 | | | | | | |
| N. 1,742,008 | 0-9 | Water | | S1 | 17.4 to | |
| E. 224,672 | 9-14 | 0 | 3600 | | 18.0 | Silty SAND |
| EL. 237.0 | 14-18 | 5 | 710 | S2 | 23.6 to | |
| | 18-24 | 12 | 300 | | 24.2 | Silty SAND |
| | 24-28 | 17 | 212 | S3 | 29.6 to | |
| | 28-30 | 15 | 240 | | 30.2 | Silty SAND |
| | 30-34 | 23 | 160 | | | |
| | 34-37 | 20 | 180 | | | |
| | 37-39 | 27 | 133 | | | |
| | 39-42 | 32 | 112 | | | |
| | 42-42.3 | 80 | 45 | | | |
| | Refusal | | | | | |
| PH-4359 | | | | | | |
| N. 1,741,977 | 0-1.7 | Water | | S1 | 9.6 | Silty SAND |
| E. 225,691 | 1.7-3 | 10 | 360 | | | |
| EL. 235.1 | 3-5 | 32 | 112 | | | |
| | 5-9 | 14 | 257 | | | |
| | 9-10 | 21 | 171 | | | |
| | 10-11 | 41 | 88 | | | |
| | 11-11.6 | 106 | 34 | | | |
| | Refusal | | | | | |
| PH-4360 | | | | | | |
| N. 1,742,209 | 0-1 | 5 | 600 | | | Many boulders on |
| E. 225,588 | 1-2 | 3 | 1200 | | | surface in this |
| EL. 240.2 | 2-3 | 10 | 360 | | | area |
| | 3-4 | 30 | 120 | | | |
| | 4-5 | 37 | 97 | | | |
| | 5-5.6 | 83 | 43 | | | |
| | Refusal | | | | | |
| PH4361 | | | | | | |
| N. 1,742,313 | 0-1 | 13 | 277 | | | Many boulders on |
| E. 225,443 | 1-2 | 36 | 100 | | | surface in this |
| EL. 240.2 | 2-2.8 | 60 | 60 | | | area |
| | Bottom of Hole | Refusal on three attempts | | | | |
| PH-4362 | | | | | | |
| N. 1,742,150 | 0-26.6 | Water | | | | |
| E. 225,936 | | | | | | |
| EL. 234.9 | | | | | | |
| PH-4363 | | | | | | |
| N. 1,742,558 | 0-18.2 | Water | | | | |
| E. 225,791 | 18.2-21 | 5 | 718 | | | |
| EL. 234.9 | 21-22 | 9 | 400 | | | |
| | 22-24 | 14 | 257 | | | |
| | Refusal | | | | | |
| PH-4364 | | | | | | |
| N. 1,742,558 | 0-4.6 | Water | | S1 | 10.6 | Silty SAND |
| E. 225,647 | 4.6-6 | 4 | 900 | | | |
| EL. 234.9 | 6-8 | 12 | 300 | | | Many boulders & |
| | 8-9 | 23 | 156 | | | cobbles on sur- |
| | 9-11 | 43 | 84 | | | face on bottom |
| | 11-12 | 60 | 60 | | | |
| | 12-13 | 49 | 73 | | | |
| | 13-14 | 100 | 36 | | | |
| | 14-14.2 | 85 | 42 | | | |
| | Refusal | | | | | |
| PH-4365 | | | | | | |
| N. 1,742,528 | 0-25.1 | Water | | | | Stones on river |
| E. 226,036 | | | | | | bottom |
| EL. 234.9 | | | | | | |
| PH-4366 | | | | | | |
| N. 1,742,[illegible]8 | 0-1 | 5 | 718 | | | Large boulders |
| E. 22[illegible] | 1-3 | 21 | 175 | | | on surface in |
| EL. 248.1 | 3-4 | 42 | 86 | | | this area |
| | 4-5 | 108 | 33 | | | |
| | 5-6 | 253 | 14.2 | | | |
| | Bottom of Hole | | | | | |
| PH-4367 | | | | | | |
| N. 1,742,687 | 0-1 | 11 | 327 | | | |
| E. 226,260 | 1-2 | 55 | 65 | | | |
| EL. 240.4 | 2-3 | 118 | 30 | | | |
| | 3-3.4 | 70 | 51 | | | |
| | Refusal | on four attempts | | | | |
| PH-4368 | | | | | | |
| N. 1,742,905 | 0-19 | Water | | | | Stones on river |
| E. 226,136 | 19-19.8 | 35 | 103 | | | bottom |
| EL. 235.3 | Refusal | on three attempts | | | | |
| PH-4369 | | | | | | |
| N. 1,742,845 | 0-1 | 11 | 327 | S1 | 7.6 | Silty SAND |
| E. 226,914 | 1-4 | 23 | 156 | | | |
| EL. 241.2 | 4-5 | 33 | 109 | | | |
| | 5-7 | 21 | 171 | | | |
| | 7-11 | [illegible] | 200 | | | |
| | 11-11.4 | 43 | 84 | | | |
| | Refusal | | | | | |
| PH-4370 | | | | | | |
| N. 1,743,049 | 0-2 | 2 | 1800 | | | |
| E. 226,770 | 2-3 | 6 | 600 | | | |
| EL. 237.2 | 3-5 | 16 | 225 | | | |
| | 5-6 | 26 | 138 | | | |
| | 6-6.7 | 36 | 100 | | | |
| | Refusal | | | | | |
| PH-4371 | | | | | | |
| N. 1,743,253 | 0-9.9 | Water | | | | |
| E. 226,625 | 9.9-11 | 4 | 900 | | | |
| EL. 235/3 | 11-13 | 6 | 600 | | | |
| | 13-14 | 26 | 138 | | | |
| | 14-15 | 76 | 47 | | | |
| | Refusal on four attempts | | | | | |
| PH-4372 | | | | | | |
| N. 1,743,426 | 0-3.7 | Water | | | | |
| E. 226,870 | 3.7-5 | 6 | 600 | | | |
| EL. 235.3 | 5-6 | 48 | 75 | | | |
| | 6-7 | 120 | 30 | | | |
| | 7-9 | 63 | 57 | | | |
| | 9-9.3 | 337 | 10.7 | | | |
| | Refusal | | | | | |
| PH-4373 | | | | | | |
| N. 1,743,192 | 0-10.3 | Water | | S1 | 21.0 | SILT & CLAY |
| E. 227,404 | 10.3-20.6 | 0 | 3600 | | | |
| EL. 235.8 | 20.6-28 | 10 | 360 | | | |
| | 28-28.8 | 20 | 180 | | | |
| | Refusal | | | | | |
| PH-4374 | | | | | | |
| N. 1,743,396 | 0-16.5 | Water | | | | |
| E. 227,259 | 16.5-20.3 | CSQ. wt. | | | | |
| EL. 235.8 | 20.3-26 | 11 | 327 | | | |
| | 26-30.1 | 30 | 120 | | | |
| | Refusal | | | | | |
| PH-4375 | | | | | | |
| N. 1,743,600 | 0-11.1 | Water | | | | |
| E. 227,114 | 11.1-17.5 | csq. wt. | | | | |
| EL. 235.8 | 17.5-18.5 | Ham. wt. | | | | |
| | 18.5-20 | 15 | 240 | | | |
| | 20-22 | 49 | 73 | | | |
| | 22-29.4 | 35 | [illegible] | | | |
| | Refusal | | | | | |
| PH-4376 | | | | | | |
| N. 1,743,539 | 0-27 | Water | | | | |
| E. 227,893 | 27-28 | 22 | 163 | | | |
| EL. 235.8 | 28-29.5 | 15 | 240 | | | |
| | Refusal | | | | | |
| PH-4377 | | | | | | |
| N. 1,743,743 | 0-19.6 | Water | | | | |
| E. 227,748 | 19.6-21 | 22 | 163 | | | |
| EL. 235.8 | 21-25 | 12 | 300 | | | |
| | 25-26. | 30 | 120 | | | |
| | 26-26.1 | 50 | 72 | | | |
| | Refusal | | | | | |
| PH-4378 | | | | | | |
| N. 1,743,947 | 0-25 | Swift Water | | | | |
| E. 227,604 | | | | | | |
| EL. 235.8 | | | | | | |
| PH-4379 | | | | | | |
| N. 1,745,221 | 0-12 | Water | | | | |
| E. 229,398 | 12-15 | 4 | 900 | | | |
| EL. 233.7 | 15-16 | 19 | 189 | | | |
| | 16-19 | 33 | 109 | | | |
| | 19-20.2 | 45 | [illegible] | | | |
| | Refusal | | | | | |
| PH-4380 | | | | | | |
| N. 1,745,510 | 0-3 | Water | | | | |
| E. 229,805 | 3-11 | 3 | 1200 | S1 | 8.8 to | |
| EL. 233.7 | 11-19 | 7 | 521 | | 9.4 | Silty SAND |
| | 19-21 | 24 | 150 | S2 | 13.8 to | |
| | 21-21.8 | 30 | 120 | | 14.4 | Silty SAND |
| | Refusal | | | | | |
| PH-4381 | | | | | | |
| N. 1,745,648 | 0-24 | Very Swift Water | | | | |
| E. 230,050 | | | | | | |
| EL. 233.7 | | | | | | |

FILE NO. GC-A-2/9
PLATE-9

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



LEGEND:

- ● Drill Holes since Oct. 1940.
- ▲ Center of Seismic Line
- ● Drill Holes drilled prior to Oct. 1940.
- ●PH Denotes Hole probed by Highmark Probing.
- R Denotes Rock Elevation.
- NR Denotes bottom elevation of Hole not drilled to Rock.
- WR Denotes bottom elevation of Wash Boring, probable rock
- —— Rock contour

NOTES

Elevations conform to U.S.G.S. datum. (M.S.L., 1912 adj.)
Location of Holes drilled since Oct. 1940 obtained by survey
Accuracy of location of holes drilled prior to Oct. 1940 not known
Topography obtained by 1940-1941 survey.

ST. LAWRENCE RIVER PROJECT
CHANNELS, AND CUTS
ROCK CONTOUR MAP
VICINITY OF GALOP ISLAND

IN SHEETS SHEET NO SCALE 1" = 500'

500 0 500 1000

U. S. ENGINEER OFFICE, MASSENA, NEW YORK JAN 1942

SUBMITTED: R M Haynes ENGINEER

RECOMMENDED: HEAD ENGR COL. CORPS OF ENGINEERS

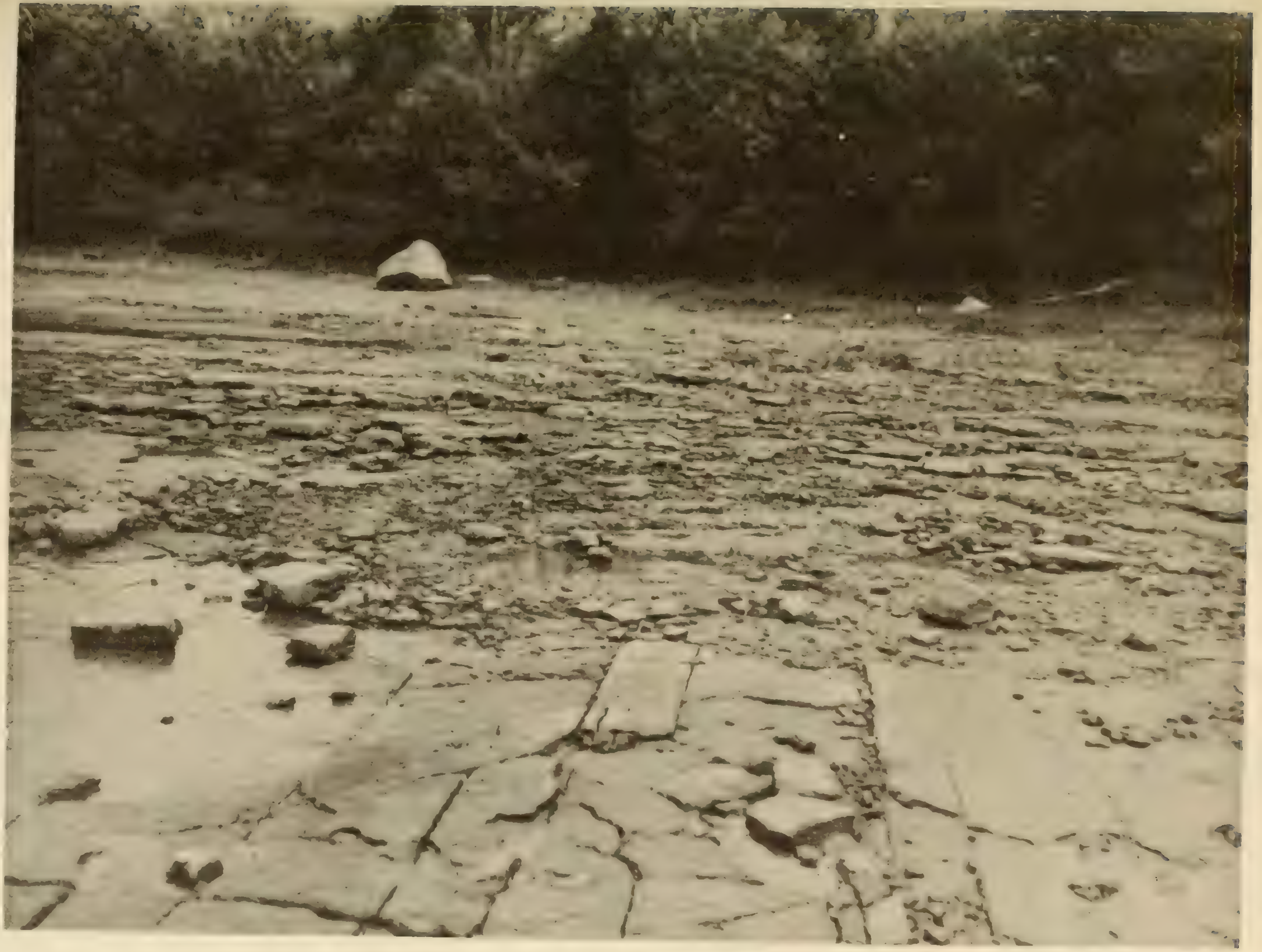
APPROVED: COL. CORPS OF ENGINEERS DISTRICT ENGINEER

DRAWN BY:
CHECKED BY: G.R.B.

SC-2/200
FILE NO

TRANSMITTED WITH LETTER OR ENDORSEMENT DATED 19

PLATE 20

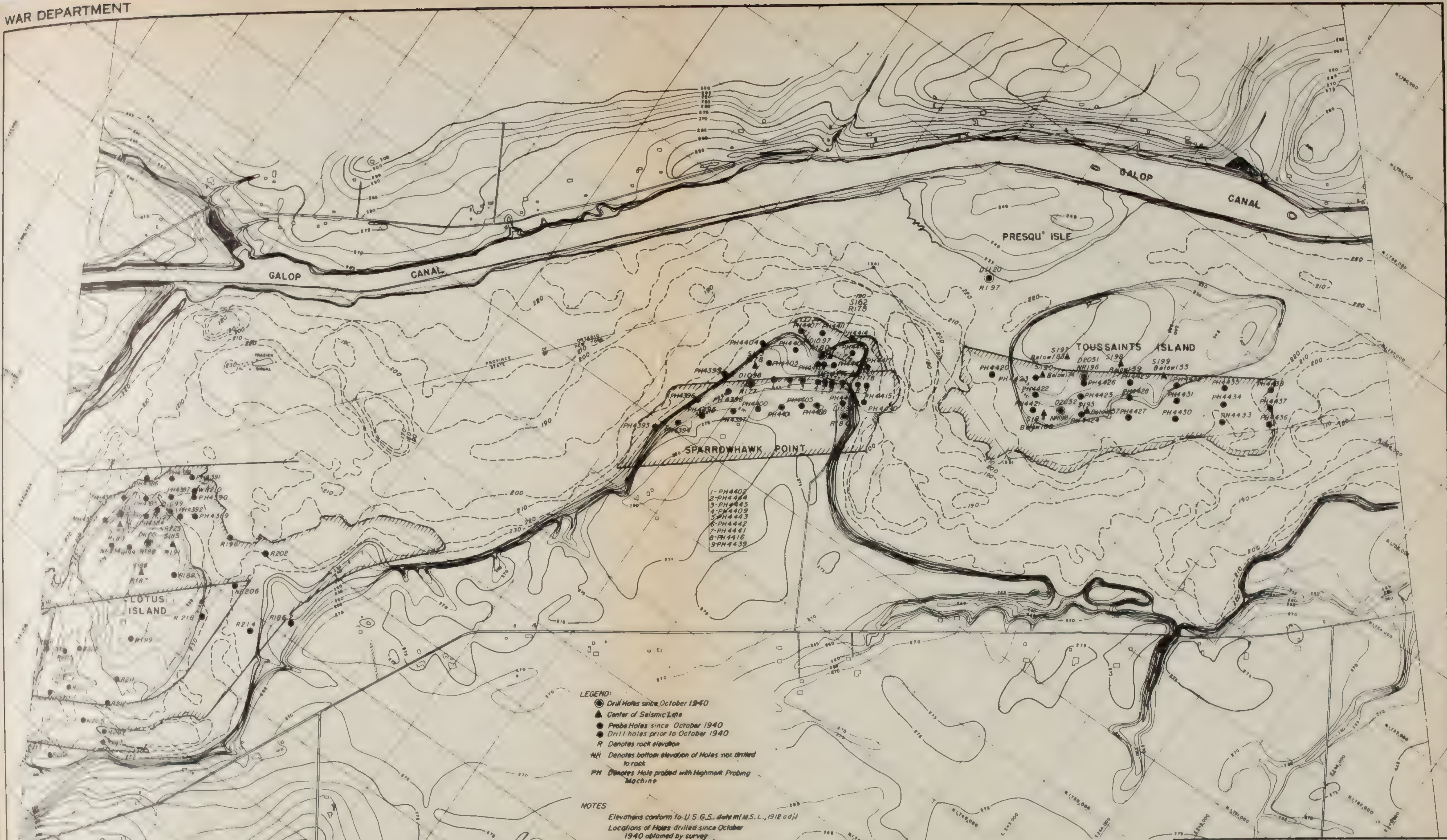


U. S. Engineer Office
St. Lawrence River District
Massena, N. Y.

Bedrock Outcropping
Middle Cove - North
Side Galop Island

October 1, 1941

File No. N-11
Plate II



LEGEND:

- ◉ Drill Holes since October 1940
- ▲ Center of Seismic Line
- ● Probe Holes since October 1940
- ● Drill holes prior to October 1940
- R Denotes rock elevation
- NR Denotes bottom elevation of Holes not drilled to rock
- PH Denotes Hole probed with Highmark Probing Machine

NOTES:

Elevations conform to U.S.G.S. datum (M.S.L., 1912 adj)

Locations of Holes drilled since October 1940 obtained by survey

Accuracy of locations of Holes drilled during 1925-1935 is not known

Topography obtained by 1940-1941 survey

ST. LAWRENCE RIVER PROJECT

CHANNELS AND CUTS

PLAN OF EXPLORATION

VICINITY OF LOTUS ISLAND, SPARROWHAWK POINT & TOUSSAINTS ISLAND

IN SHEETS SHEET NO SCALE 1" = 500

500 0 500 1000

U S ENGINEER OFFICE, MASSENA, NEW YORK FEBRUARY, 1942

SUBMITTED R M Hanna ENGINEER

RECOMMENDED E. Smith LT. COL. CORPS OF ENGINEERS

APPROVED: COL. CORPS OF ENGINEERS DISTRICT ENGINEER

DRAWN BY JP

CHECKED BY CE

GQC-A-2/1 FILE NO

TRANSMITTED WITH LETTER OR ENDORSEMENT DATED 1941

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY

## D1096

| | | |
|---|---|---|
| 0.0 | El 270.0 | Fairly soft variable brown to grey slightly sandy SILT & CLAY |
| 16.5 | El 254.0 | Soft grey slightly silty CLAY |
| 40.5 | El 230.0 | Compact grey slightly gravelly silty SAND |
| 56.0 | El 214.5 | Compact grey SAND & Gravel Numerous boulders |
| 90.6 | El 179.9 | DOLOMITE hard considerable calcite throughout Rock sound and unweathered |
| 107.6 | El 162.9 | |
| 110.6 | El 159.9 | LIMESTONE dolomitic hard few stringers of shale Rock sound and unweathered |
| | | Rock core recovery 96% |

## D1097

| | | |
|---|---|---|
| 0.0 | El 233.0 | Compact grey slightly gravelly silty SAND |
| 16.5 | El 216.5 | Compact brown SAND |
| 20.0 | El 213.0 | Very compact grey slightly gravelly silty SAND |
| 52.7 | El 180.3 | DOLOMITE hard few stringers of shale and numerous stringers and crystals of calcite Considerable pyrite throughout Rock broken but unweathered |
| 72.7 | El 160.3 | Rock core recovery 99.5% |

## D1098

| | | |
|---|---|---|
| 0.0 | El 257.4 | Fairly compact brown gravelly and slightly silty SAND |
| 17.0 | El 240.4 | Fairly compact brown slightly gravelly SAND & SILT |
| 20.5 | El 236.9 | Compact grey gravelly SAND & SILT |
| 28.0 | El 229.4 | Fairly compact brown gravelly SAND & SILT |
| 37.8 | El 219.6 | Compact grey gravelly SAND & SILT |
| 56.0 | El 201.4 | Compact grey sandy and slightly gravelly SILT |
| 80.4 | El 177.0 | DOLOMITE grey hard few stringers of shale and considerable calcite throughout Rock broken but unweathered |
| 100.4 | El 157.4 | Rock core recovery 86% |

## D1099

| | | |
|---|---|---|
| 0.0 | El 236.0 | Very compact grey slightly silty SAND & GRAVEL |
| 9.8 | El 226.2 | Very compact grey slightly gravelly silty SAND. Occasional boulders. |
| 39.2 | El 196.8 | DOLOMITE dark grey hard few stringers of shale Broken along occasional vertical joints. Rock unweathered. |
| 59.6 | El 176.4 | Rock core recovery 94% |

## D1100

| | | |
|---|---|---|
| 0.0 | El 245.7 | Compact greyish brown slightly gravelly silty SAND. |
| 15.0 | El 230.7 | Compact grey slightly silty gravelly SAND. |
| 57.5 | El 188.2 | DOLOMITE dark grey hard Rock slightly weathered along few joints and occasional shale partings. |
| 77.6 | El 168.2 | Rock core recovery 92.4% |

## D1101

| | | |
|---|---|---|
| 0.0 | El 241.4 | Compact grey slightly silty SAND & GRAVEL |
| 15.0 | El 226.4 | Compact grey slightly gravelly silty SAND |
| 61.0 | El 180.4 | DOLOMITE recemented FAULTBRECCIA Entire rock weathered and badly fractured and broken |
| 81.3 | El 160.1 | Rock core recovery 34% |

## D2051

| | | |
|---|---|---|
| 0.0 | El 241.0 | Fairly compact brown slightly gravelly silty SAND. Occasional boulders. |
| 12.0 | El 229.0 | Compact grey slightly clayey slightly gravelly silty SAND. Occasional boulders. |
| 45.0 | El 196.0 | |

## D2052

| | | |
|---|---|---|
| 0.0 | El 238.1 | Fairly loose, brown slightly gravelly, silty, SAND. |
| 9.8 | El 228.3 | Fairly compact, grey, slightly clayey, slightly gravelly, silty SAND. |
| 25.0 | El 213.1 | Fairly compact to compact, grey, slightly gravelly, silty SAND. Occasional boulders. |
| 43.1 | El 195.0 | |

## D 120

| | | |
|---|---|---|
| 0.0 | El 232.8 | Soft gray slightly clayey slightly gravelly silty SAND |
| 8.5 | El 224.3 | Compact grey slightly gravelly silty SAND |
| 35.8 | El 197.0 | DOLOMITE dark grey hard Considerable calcite throughout Few slightly weathered broken seams |
| 65.8 | El 167.0 | Rock core recovery 94.5% |

### DESCRIPTIVE TERMS

Slightly silty etc denotes approximately 1% to 20% by dry weight of silt etc.

Silty etc denotes approximately 20% to 40% by dry weight of silt

Silt and sand etc denotes 40% to 60% by dry wt of silt etc except "and clay" denotes more than 30% by dry wt of clay.

| TRANSVERSE MERCATOR COORDINATES | | |
|---|---|---|
| HOLE NO. | NORTH | EAST |
| D 1096 | 1,752,380 | 238,225 |
| D1097 | 1,752,870 | 237,570 |
| D1098 | 1 752,060 | 237,050 |
| D1099 | 1,746,481 | 231,847 |
| D1100 | 1,745 948 | 231,861 |
| D1101 | 1,746,031 | 231,385 |
| D2051 | 1,754,540 | 240,470 |
| D2052 | 1,754,010 | 240,470 |
| | | |

NOTE

Analyses of overburden materials are based on dry samples

Analyses of bedrock are based on cores obtained by drilling

ST. LAWRENCE RIVER PROJECT
VICINITY OF LOTUS ISL, SPARROWHAWK PT,
AND TOUSSAINT ISLAND
RECORD OF EXPLORATION

IN SHEETS SHEET NO. SCALE

10' 5' 0 10' 20' 30'

U.S. ENGINEER OFFICE, MASSENA, NEW YORK FEBRUARY, 1942

SUBMITTED: R. M. Haines ENGINEER

RECOMMENDED: HEAD ENGR LT. COL. CORPS OF ENGINEERS

APPROVED: COL. CORPS OF ENGINEERS DISTRICT ENGINEER

DRAWN BY:
CHECKED BY: G.R.B.

FILE NO GQC-A-2/2

TRANSMITTED WITH LETTER OR ENDORSEMENT DATED 194

ST. LAWRENCE RIVER

VICINITY LOTUS ISLAND, SPARROWHAWK

POINT, & TOUSSAINTS ISLAND

| Probing No. Coordinates and Surface Elevation | Depth in Feet | Blows per Foot | Feet per Hour | Samples No. | Samples Depth | Description of Samples |
|---|---|---|---|---|---|---|
| LOTUS ISLAND | | | | | | |
| PH-4382 | | | | | | |
| N. 1,745,855 | 0-3.3 | Water | | | | Many boulders |
| E. 231,155 | 3.3-4 | 22 | 160 | | | on river bottom |
| EL. 231.6 | 4-6 | 69 | 52 | | | |
| | 6-7 | 166 | 22 | | | |
| | 7-7.5 | 224 | 16 | | | |
| | Refusal on three attempts | | | | | |
| PH-4383 | | | | | | |
| N. 1,746,232 | 0-5.8 | Water | | | | |
| E. 231,255 | 5.8-7 | 22 | 160 | | | Many boulders |
| EL. 231.6 | 7-8 | 106 | 34 | | | on river bottom |
| | 8-8.8 | 312 | 12 | | | |
| | No Refusal | | | | | |
| PH-4384 | | | | | | |
| N. 1,746,202 | 0-2 | Water | | | | Many boulders |
| E. 231,644 | 2-3 | 10 | 360 | | | along shoreline |
| EL. 232.0 | 3-4 | 23 | 155 | | | |
| | 4-5 | 612 | 6 | S1 | 3.0 | Sandy SILT |
| | Refusal on three attempts | | | | to 5.0 | |
| PH-4385 | | | | | | |
| N. 1,746,406 | 0-10.5 | Water | | | | |
| E. 231,499 | 10.5-11 | 10 | 360 | | | Many boulders on |
| EL. 231.6 | 11-12 | 22 | 160 | | | shore and under |
| | 12-12.2 | 60 | 60 | | | water of bay |
| | Refusal on four attempts | | | | | |
| PH-4386 | | | | | | |
| N. 1,746,610 | 0-26 | Water | | | | |
| E. 231,355 | | | | | | |
| EL. 231.6 | | | | | | |
| PH-4387 | | | | | | |
| N. 1,746,609 | 0-3 | Water | | S1 | 4.0 | |
| E. 231,785 | 3-4 | 49 | 73 | | to 5.2 | Silty SAND |
| EL. 231.6 | 4-5 | 212 | 17 | | | |
| | 5-5.2 | 432 | 8 | | | |
| | Refusal | | | | | |
| PH-4388 | | | | | | |
| N. 1,746,812 | 0-17 | Water | | | | |
| E. 231,640 | 17-18 | 21 | 170 | | | |
| EL. 231.6 | 18-20 | 63 | 57 | | | |
| | No Refusal | | | | | |
| PH-4389 | | | | | | |
| N. 1,746,578 | 0-3 | Water | | | | |
| E. 232,174 | 3-6 | 6 | 600 | S1 | 8.6 | |
| EL. 231.6 | 6-9 | 14 | 260 | | to 9.2 | SAND |
| | 9-10 | [illegible] | 20 | | | |
| | 10-10/1 | 950 | 4 | | | |
| PH-4390 | | | | | | |
| N. 1,746,782 | 0-12.5 | Water | | | | |
| E. 232,029 | 12.5-18.2 | 1 | 3600 | S1 | 14.4 | |
| EL. 231.6 | 18.2-19 | 48 | 75 | | to15.0 | SAND |
| | 19-22 | 73 | 49 | | | |
| | 22-23 | 190 | 19 | | | |
| | 23-23.5 | 540 | 7 | | | |
| PH-4391 | | | | | | |
| N. 1,746,986 | 0-20 | Water | | | | |
| E. 231,884 | | | | | | |
| EL. 231.6 | | | | | | |
| PH-4392 | | | | | | |
| N. 1 | | | | | | |
| E. | | | | | | |
| EL. 231.6 | 0-2.4 | Water | | | | |
| | 2.4-4 | 4 | 900 | | | Some boulders |
| | 4-5 | 82 | 44 | | | in this area. |
| | 5-6 | 168 | 21 | | | |
| | 6-6.6 | 334 | 11 | | | |
| | No Refusal | | | | | |
| SPARROWHAWK POINT | | | | | | |
| PH-4393 | | | | | | |
| N. 1,750,902 | 0-2 | Water | | | | Many boulders on |
| E. 230,377 | 2-3.7 | 219 | 17 | S1 | 4.5 | shore line |
| EL. | 3.7-4.4 | 600 | 6 | | to5.4 | Silty SAND |
| | No Refusal | | | | | |
| PH-4394 | | | | | | |
| N. 1,751,128 | 0-3 | 17 | 210 | | | Some large |
| E. 236,573 | 3-4 | 128 | 28 | | | boulders in |
| EL. | 4-5 | 165 | 22 | | | this area |
| | 5-7 | 142 | 25 | | | |
| | 7-8 | 219 | 16 | | | |
| | No Refusal | | | | | |

| Probing No. Coordinates and Surface Elevation | Depth in Feet | Blows per Foot | Feet per Hour | Samples No. | Samples Depth | Description of Samples |
|---|---|---|---|---|---|---|
| PH-4395 | | | | | | |
| N. 1,751,355 | 0-2 | 8 | 450 | | | Some boulders is |
| E. 236,770 | 2-3 | 44 | [illegible] | | | this area |
| EL. | 3-7 | 106 | 34 | | | |
| | 7-8 | 69 | 52 | | | |
| | 8-9 | 150 | 24 | | | |
| | 9-9.2 | [illegible] | 5 | | | |
| | Refusal | | | | | |
| PH-4396 | | | | | | |
| N. 1,751,500 | 0-4 | 8 | 450 | | | Very many |
| E. 236,601 | 4-5 | 58 | 62 | | | boulders in this |
| EL. | 5-6 | 231 | 16 | | | area |
| | No Refusal | | | | | |
| PH-4397 | | | | | | |
| N. 1,751,622 | 0-2 | 4 | 900 | S1 | 0.6 | Sandy SILT |
| E. 237,873 | 2-5 | 9 | 400 | | | |
| EL. | 5-8 | 5 | 720 | | | |
| | 8-10 | 15 | 240 | | | |
| | 10-10.6 | 270 | 13 | | | |
| | Refusal | | | | | |
| PH-4398 | | | | | | |
| N. 1,751,802 | 0-2 | 5 | 600 | | | Some boulders in |
| E. 236,863 | 2-4 | 13 | 275 | | | this area |
| EL. | 4-5 | 33 | 110 | | | |
| | 5-7 | 140 | 26 | | | |
| | 7-7.7 | 320 | | | | |
| | No Refusal | | | | | |
| PH-4399 | | | | | | |
| N. 1,751,947 | 0-2.1 | Water | | | | Many boulders in |
| E. 236,696 | 2.1-3 | [illegible] | 450 | | | this area |
| EL. 230.3 | 3-4 | 74 | 49 | | | |
| | 4-5 | 210 | 17 | | | |
| | 5-6 | 283 | 13 | | | |
| | No Refusal | | | | | |
| PH-4400 | | | | | | |
| N. 1,751,816 | 0-2 | 4 | 900 | [illegible] | 6.6 | SILT & CLAY |
| E. 237,307 | 2-11 | 16 | 225 | | | |
| EL. 269.0 | 11-12 | 125 | 29 | | | |
| | 12-13 | [illegible] | 13 | | | |
| | No Refusal | | | | | |
| PH-4401 | | | | | | |
| N. 1,752,009 | 0-11 | 11 | 327 | S1 | 6.6 | Sandy SILT |
| E. 237,539 | 11-18 | 23 | 156 | S2 | 11.6 | SILT & CLAY |
| EL. 271.0 | 18-23 | 38 | 95 | S3 | 18.6 | Clayey SILT |
| | 23-24 | 135 | 26 | S4 | 23.6 | Sandy SILT |
| | 24-24.7 | 326 | 11 | | | |
| | No Refusal | | | | | |
| PH-4402 | | | | | | |
| N. 1,752,255 | 0-2 | 6 | 600 | | | |
| E. 237,256 | 2-4 | 16 | 225 | | | |
| EL. 258.2 | 4-5 | 52 | 69 | | | |
| | 5-6 | 102 | 35 | | | |
| | 6-6.6 | 360 | 10 | | | |
| | No Refusal | | | | | |
| PH-4403 | | | | | | |
| N. 1,752,400 | 0-2 | 14 | 259 | | | Many boulders in |
| E. 237,089 | 2-3 | 36 | 100 | | | this area |
| EL. 256.3 | 3-4 | 90 | 40 | | | |
| | 4-5 | 156 | 23 | | | |
| | 5-6 | 203 | 18 | | | |
| | No Refusal | | | | | |
| PH-4404 | | | | | | |
| N. 1,752,550 | 0-2.5 | Water | | | | Many boulders on |
| E. 236,916 | 2.5-3 | 10 | 360 | S1 | 5.0 | shore & bottom |
| EL. 230.3 | 3-4 | 36 | 100 | | to5.6 | Sandy SILT |
| | 4-5 | 104 | 34 | | | |
| | 5-5.2 | 750 | 5 | | | |
| | 5.2-6.6 | 333 | 11 | | | |
| | No Refusal | | | | | |
| PH-4405 | | | | | | |
| N. 1,752,168 | 0-13 | 7 | 514 | S1 | 6.6 | Sandy SILT |
| E. 237,744 | 13-21 | 19 | 189 | S2 | 11.6 | SILT & CLAY |
| EL. 267.4 | 21-31 | 33 | 109 | S3 | 17.6 | Silty CLAY |
| | 31-42 | 52 | 69 | S4 | 22.6 | Silty CLAY |
| | 42-45 | 139 | 26 | S5 | 28.6 | |
| | 45-46 | 224 | 16 | S6 | 34.6 | Silty CLAY |
| | No Refusal | | | | | |
| PH-4406 | | | | | | |
| N. 1,752,737 | 0-3 | 7 | 515 | | | Some large |
| E. 237,276 | 3-4 | 77 | 47 | | | boulders in this |
| EL. 244.3 | 4-4.5 | 400 | 9 | | | area |
| | No Refusal | | | | | |

FILE NO. GQC-A-2/3

PLATE-14

## ST. LAWRENCE RIVER

## VICINITY LOTUS ISLAND, SPARROWHAWK POINT, & TOUSSAINTS ISLAND

| Probing No. Coordinates and Surface Elevation | Depth in Feet | Blows per Foot | Feet per Hour | Samples No. | Samples Depth | Description of Samples |
|---|---|---|---|---|---|---|
| PH-4407 | | | | | | |
| N. 1,752,978 | 0-2.5 | Water | | | | Many boulders in this area |
| E. 237,190 | 2.5-3 | 12 | 300 | | | |
| El. 230.3 | 3-7 | 81 | 44 | | | |
| | 7-8 | 137 | 26 | | | |
| | 8-9 | 231 | 15 | | | |
| | No Refusal | | | | | |
| PH-4408 | | | | | | |
| N. 1,752,299 | 0-7 | 5 | 600 | S1 | 7.6 | Sandy, silty CLAY |
| E. 237,898 | | | | | | |
| El. 270.6 | 7-12 | 14 | 257 | S2 | 12.6 | SILT & CLAY |
| | 12-15 | 25 | 144 | | | |
| | 15-28 | 38 | 95 | S3 | 17.6 | Sandy, clayey, SILT |
| | 28-29 | 93 | 39 | S4 | | |
| | 29-29.6 | 333 | 11 | | 23.6 | Sandy, clayey, SILT |
| | No Refusal | | | | | |
| | | | | S5 | 28.6 | Sandy, clayey, SILT |
| PH-4409 | | | | | | |
| N. 1,752,554 | 0-9 | 10 | 360 | S1 | 7.6 | Sandy SILT |
| E. 237,741 | 9-15 | 31 | 116 | S2 | 12.6 | SILT & CLAY |
| El. 259.1 | 15-35 | 51 | 70 | S3 | 17.6 | SILT & CLAY |
| | 35-37 | 82 | 44 | S4 | 22.6 | Sandy SILT & CLAY |
| | 37-38 | 203 | 17 | | | |
| | | | | S5 | 28.6 | SILT & CLAY |
| | | | | S6 | | Clayey SILT & SAND |
| PH-4410 | | | | | | |
| N. 1,752,742 | 0-10 | 11 | 327 | S1 | 6.6 | SILT & CLAY |
| E. 237,625 | 10-18 | 21 | 171 | S2 | 12.6 | SAND & SILT |
| El. 241.4 | 18-19 | 221 | 16 | | | |
| | No Refusal | | | | | |
| PH-4411 | | | | | | |
| N. 1,753,086 | 0-2 | Water | | | | |
| E. 237,413 | 2-3 | 1 | 3600 | | | |
| El. 230.3 | 3-5 | 3 | 1200 | | | |
| | 5-6 | 14 | 257 | | | |
| | 6-7 | 100 | 36 | | | |
| | 7-8 | 200 | 18 | | | |
| | 8-8.5 | 400 | 9 | | | |
| | No Refusal | | | | | |
| PH-4412 | | | | | | |
| N. 1,752,499 | 0-2 | 3 | 1200 | S1 | 7.6 | Silty SAND |
| E. 238,128 | 2-8 | 13 | 277 | S2 | 12.6 | Sandy SILT & CLAY |
| El. 270.0 | 8-11 | 24 | 150 | | | |
| | 11-22 | 44 | 82 | S3 | 17.6 | Sandy SILT & CLAY |
| | 22-22.3 | 260 | 14 | | | |
| | Refusal | | | | | |
| PH-4413 | | | | | | |
| N. 1,753,105 | 0-2 | 6 | 600 | S1 | 7.6 | Silty SAND |
| E. 237,872 | 2-7 | 50 | 72 | | | |
| El. 250.2 | 7-8 | 75 | 48 | | | |
| | 8-8.8 | 250 | 14 | | | |
| | No Refusal | | | | | |
| PH-4414 | | | | | | |
| N. 1,753,254 | 0-2.5 | Water | | | | Many boulders in this area |
| E. 237,780 | 2.5-3 | 2 | 1800 | | | |
| El. 230.3 | 3-4 | 110 | 33 | | | |
| | 4-4.2 | 285 | 13 | | | |
| | Refusal on four attempts | | | | | |
| PH-4415 | | | | | | |
| N. 1,752,681 | 0-5 | Water | | | | |
| E. 238,368 | 5-16 | 4 | 900 | S1 | 9.8 | |
| El. 229.9 | 16-23 | 30 | 120 | | to10.4 | SILT & CLAY |
| | 23-24 | 80 | 45 | S2 | 15.8 | |
| | 24-24.5 | 500 | 7 | | to16.4 | Sandy, clayey SILT |
| | Refusal | | | | | |
| PH-4416 | | | | | | |
| N. 1,752,869 | 0-5.5 | Water | | | | |
| E. 238,252 | 5.5-8 | 1 | 3600 | S1 | 14.6 | SILT & CLAY |
| El. 229.9 | 8-14 | 3 | 1200 | | | |
| | 14-16 | 14 | 257 | S2 | 21.6 | Silty SAND |
| | 16-21 | 43 | 84 | | | |
| | 21-21.8 | 225 | 16 | | | |
| | Refusal | | | | | |
| PH-4417 | | | | | | |
| N. 1,753,057 | 0-4.5 | Water | | | | |
| E. 238,136 | 4.5-5 | 12 | 300 | S1 | 9.8 | |
| El. 229.9 | 5-15 | 26 | 138 | | to10.4 | SILT & CLAY |
| | 15-21 | 42 | 86 | S2 | 16.8 | |
| | 21-22 | 170 | 21 | | to17.4 | Silty SAND |
| | 22-22.8 | 312 | 12 | | | |
| | Refusal | | | | | |
| PH-4418 | | | | | | |
| N. 1,752,810 | 0-8 | 6 | 600 | S1 | 7.6 | Silty SAND |
| E. 238,157 | 8-10 | 27 | 133 | | | |
| El. 230.0 | 10-11 | 69 | 52 | | | |
| | 11-14 | 122 | 29 | | | |
| | 14-15 | 208 | 17 | | | |
| | No Refusal | | | | | |

| Probing No. Coordinates and Surface Elevation | Depth in Feet | Blows per Foot | Feet per Hour | Samples No. | Samples Depth | Description of Samples |
|---|---|---|---|---|---|---|
| PH-4440 | | | | | | |
| N. 1,752,622 | 0-6 | 5 | 720 | S1 | 7.6 | Silty SAND |
| E. 238,273 | 6-13 | 13 | 277 | S2 | 13.6 | Silty SAND |
| El. 230.0 | 13-16 | 45 | 80 | | | |
| | 16-17 | 75 | 48 | | | |
| | 17-19 | 129 | 28 | | | |
| | 19-19.7 | 314 | 12 | | | |
| | No Refusal | | | | | |
| PH-4441 | | | | | | |
| N. 1,752,712 | 0-1 | 4 | 900 | | | |
| E. 237,997 | 1-3 | 42 | 86 | | | |
| El. 256.8 | 3-6 | 128 | 28 | | | |
| | 6-7 | 209 | 17 | | | |
| | No Refusal | | | | | |
| PH-4442 | | | | | | |
| N. 1,752,647 | 0-2 | 6 | 600 | S1 | 7.6 | Sandy SILT |
| E. 237,893 | 2-7 | 17 | 210 | | | |
| El. 259.3 | 7-8 | 43 | 84 | | | |
| | 8-8.8 | 90 | 40 | | | |
| | Refusal | | | | | |
| PH-4443 | | | | | | |
| N. 1,752,595 | 0-10 | 13 | 277 | S1 | 7.6 | Sandy SILT |
| E. 237,808 | 10-16 | 29 | 124 | S2 | 12.6 | SILT & CLAY |
| El. 260.6 | 16-23 | 43 | 84 | S3 | 17.6 | SILT & CLAY |
| | 23-24 | 61 | 59 | S4 | 23.6 | Sandy SILT & CLAY |
| | 24-25 | 214 | 17 | | | |
| | No Refusal | | | | | |
| PH-4444 | | | | | | |
| N. 1,752,359 | 0-2 | 5 | 720 | S1 | 6.6 | Sandy SILT |
| E. 237,425 | 2-10 | 11 | 327 | S2 | 11.2 | Silty SAND |
| El. 259.2 | 10-11 | 35 | 103 | | | |
| | 11-11.8 | 262 | 14 | | | |
| | No Refusal | | | | | |
| PH- 45 | | | | | | |
| N. 1,752,449 | 0-10 | 11 | 327 | S1 | 6.6 | Clayey SILT |
| E. 237,571 | 10-12 | 20 | 180 | S2 | 12.6 | SILT & CLAY |
| El. 260.3 | 12-22 | 36 | 100 | S3 | 18.6 | SILT & CLAY |
| | 22-22.7 | 320 | 11 | | | |
| | No Refusal | | | | | |
| PH-4446 | | | | | | |
| N. 1,752,783 | 0-10 | 13 | 277 | S1 | 12.6 | SAND & SILT |
| E. 237,692 | 10-15 | 27 | 133 | | | |
| El. 242.6 | 15-21 | 53 | 68 | | | |
| | 21-22 | 158 | 23 | | | |
| | 22-23 | 216 | 17 | | | |
| | No Refusal | | | | | |
| PH-4447 | | | | | | |
| N. 1,752,835 | 0-3 | 19 | 190 | | | |
| E. 237,777 | 3-4 | 47 | 77 | | | |
| El. 247.6 | 4-7 | 92 | 39 | | | |
| | 7-8 | 151 | 24 | | | |
| | 8-8.2 | 325 | 11 | | | |
| | Refusal | | | | | |

TOUSSAINTS ISLAND

| Probing No. Coordinates and Surface Elevation | Depth in Feet | Blows per Foot | Feet per Hour | Samples No. | Samples Depth | Description of Samples |
|---|---|---|---|---|---|---|
| PH-4420 | | | | | | |
| N. 1,753,880 | 0-11 | Water | | | | |
| E. 239,473 | 11-12 | 60 | 60 | | | Very many stones & boulders on river bottom |
| El. 229.4 | 12-12.9 | 163 | 22 | | | |
| | No Refusal | | | | | |
| PH-4421 | | | | | | |
| N. 1,753,808 | 0-2 | 10 | 360 | | | Boulders in area |
| E. 240,199 | 2-3 | 51 | 70 | | | |
| El. 237.1 | 3-3.1 | 380 | 9 | | | |
| | 3.1-3.2 | 550 | 6 | | | |
| | Refusal on two attempts | | | | | |
| PH-4422 | | | | | | |
| N. 1,753,996 | 0-2 | 6 | 600 | | | Very many boulders in area |
| E. 240,083 | 2-2.8 | 54 | 67 | | | |
| El. 243.0 | 2.8-3 | 530 | 6 | | | |
| | 3-3.4 | 300 | 12 | | | |
| | No Refusal- third attempt | | | | | |
| PH-4423 | | | | | | |
| N. 1,754,184 | 0-1 | 8 | 450 | | | Many boulders in area |
| E. 239,967 | 1-2 | 36 | 100 | | | |
| El. 247.8 | 2-3 | 100 | 36 | | | |
| | 3-3.8 | 250 | 14 | | | |
| | No Refusal | | | | | |
| PH-4424 | | | | | | |
| N. 1,754,123 | 0-2 | 17 | 215 | | | Many boulders in area |
| E. 240,709 | 2-3 | 76 | 47 | | | |
| El. 232.5 | 3-3.7 | 124 | 29 | | | |
| | 3.7-4 | 820 | 4 | | | |
| | 4-4.2 | 500 | 7 | | | |
| | No Refusal- second attempt | | | | | |
| PH-4425 | | | | | | |
| N. 1,754,311 | 0-1 | 5 | 720 | | | Many boulders in area |
| E. 240,594 | 1-2 | 43 | 85 | | | |
| El. 240.3 | 2-2.6 | 291 | 12 | | | |
| | No Refusal | | | | | |

FILE NO. GQC-A-2/4

PLATE-15

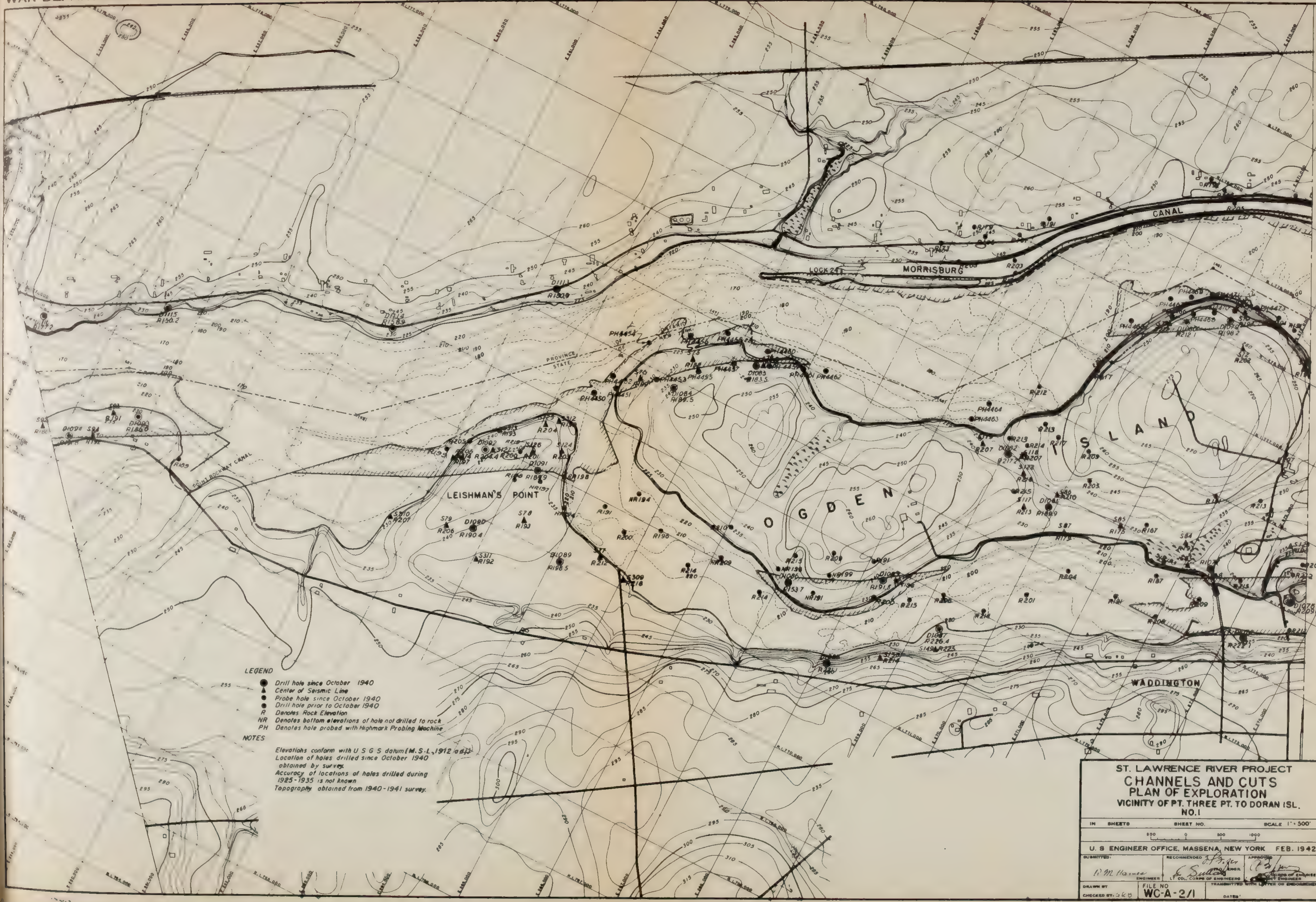
## ST. LAWRENCE RIVER

## VICINITY LOTUS ISLAND, SPARROWHAWK POINT, & TOUSSAINTS ISLAND

| Probing No. Coordinates and Surface Elevation | Depth in Feet | Blows per Foot | Feet per Hour | Samples No. | Samples Depth | Description of Samples |
|---|---|---|---|---|---|---|
| PH-4426 | | | | | | |
| N. 1,754,499 | 0-1 | 4 | 900 | | | Many boulders |
| E. 240,478 | 1-2 | 19 | 192 | | | in area |
| El. 241.3 | 2-2.4 | 110 | 31 | | | |
| | Refusal | | | | | |
| PH-4427 | | | | | | |
| N. 1,754,437 | 0-5.1 | Water | | | | |
| E. 241,220 | 5.1-10 | 6 | 600 | S1 | 10.6 | Silty SAND |
| El. 228.9 | 10-14 | 25 | 146 | | | |
| | 14-15 | 125 | 29 | | | |
| | 15-15.8 | 300 | 12 | | | |
| | No Refusal | | | | | |
| PH-4428 | | | | | | |
| N. 1,754,625 | 0-2 | 5 | 720 | | | Entire surface |
| E. 241,104 | 2-3 | 20 | 180 | | | covered with |
| El. 230.2 | 3-4 | 55 | 66 | | | boulders |
| | 4-5 | 114 | 31 | | | |
| | 5-5.2 | 400 | 9 | | | |
| | No Refusal | | | | | |
| PH-4429 | | | | | | |
| N. 1,754,814 | 0-2 | 8 | 450 | | | Some boulders |
| E. 240,989 | 2-5 | 17 | 212 | | | in area |
| El. 238.1 | 5-5.5 | 400 | 9 | | | |
| | No Refusal | | | | | |
| PH-4430 | | | | | | |
| N. 1,754,752 | 0-8.3 | Water | | | | |
| E. 241,731 | 8.3-14.2 | 1 | 3600 | S1 | 14.6 | Silty SAND |
| El. 228.9 | 14.2-15 | 11 | 327 | | | (Shells) |
| | 15-16 | 56 | 65 | | | |
| | 16-17 | 250 | 14 | | | |
| | No Refusal | | | | | |
| PH-4431 | | | | | | |
| N. 1,754,940 | 0-6.6 | Water | | | | |
| E. 241,615 | 6.6-14.4 | 1 | 3600 | S1 | 14.6 | Silty SAND |
| El. 228.9 | 14.4-15 | 5 | 720 | S2 | 23.6 | SAND & SILT |
| | 15-17 | 10 | 360 | | | |
| | 17-25 | 23 | 157 | | | |
| | 25-26 | 74 | 49 | | | |
| | 26-27 | 147 | 24 | | | |
| PH-4432 | | | | | | |
| N. 1,755,128 | 0-1 | 11 | 327 | | | Boulders in |
| E. 241,489 | 1-2 | 25 | 144 | | | area |
| El. 239.3 | 2-3 | 120 | 30 | | | |
| | 3-3.1 | 500 | 7 | | | |
| | No Refusal | | | | | |
| PH-4433 | | | | | | |
| N. 1,755,067 | 0-9 | Water | | | | Cobbles on |
| E. 242,242 | 9-10 | 10 | 360 | | | river bottom |
| El. 228.9 | 10-10.7 | 33 | 109 | | | |
| | Refusal | | | | | |
| PH-4434 | | | | | | |
| N. 1,755,255 | 0-7.5 | Water | | | | |
| E. 242,126 | 7.5-10 | 6 | 600 | | | Boulders on |
| El. 228.9 | 10-11 | 26 | 138 | | | river bottom |
| | 11-13 | 84 | 43 | | | |
| | 13-13.9 | 200 | 18 | | | |
| | Refusal | | | | | |
| PH-4435 | | | | | | |
| N. 1,755,443 | 0-5 | Water | | | | |
| E. 242,010 | 5-6 | 13 | 277 | | | Many boulders |
| El. 228.9 | 6-9 | 51 | 70 | | | on river |
| | 9-10 | 141 | 25 | | | bottom |
| | 10-10.5 | 410 | 9 | | | |
| | Refusal | | | | | |
| PH-4436 | | | | | | |
| N. 1,755,381 | 0-12 | Water | | | | |
| E. 242,753 | | | | | | |
| El. 228.9 | | | | | | |
| PH-4437 | | | | | | |
| N. 1,755,569 | 0-12.2 | Water | | | | |
| E. 242,637 | 12.2-15 | 13 | 277 | | | |
| El. 228.9 | 15-19 | 20 | 180 | | | |
| | 19-24 | 44 | 82 | | | |
| | 24-24.2 | 65 | 55 | | | |
| | Refusal | | | | | |
| PH-4438 | | | | | | |
| N. 1,755,758 | 0-24 | Water | | | | |
| E. 242,521 | 24-24.4 | 15 | 240 | | | |
| El. 228.9 | Refusal | | | | | |

| Probing No. Coordinates and Surface Elevation | Depth in Feet | Blows per Foot | Feet per Hour | Samples No. | Samples Depth | Description of Samples |
|---|---|---|---|---|---|---|

FILE NO GQC-A-2/5
PLATE-16



LEGEND

- ● Drill hole since October 1940
- ▲ Center of Seismic Line
- ● Probe hole since October 1940
- ● Drill hole prior to October 1940
- R Denotes Rock Elevation
- NR Denotes bottom elevations of hole not drilled to rock
- PH Denotes hole probed with Highmark Probing Machine

NOTES

Elevations conform with U S G S datum (M.S.L., 1912 adj.)
Location of holes drilled since October 1940 obtained by survey.
Accuracy of locations of holes drilled during 1925-1935 is not known
Topography obtained from 1940-1941 survey.

ST. LAWRENCE RIVER PROJECT
CHANNELS AND CUTS
PLAN OF EXPLORATION
VICINITY OF PT. THREE PT. TO DORAN ISL.
NO. 1

IN SHEETS SHEET NO. SCALE 1" = 500'

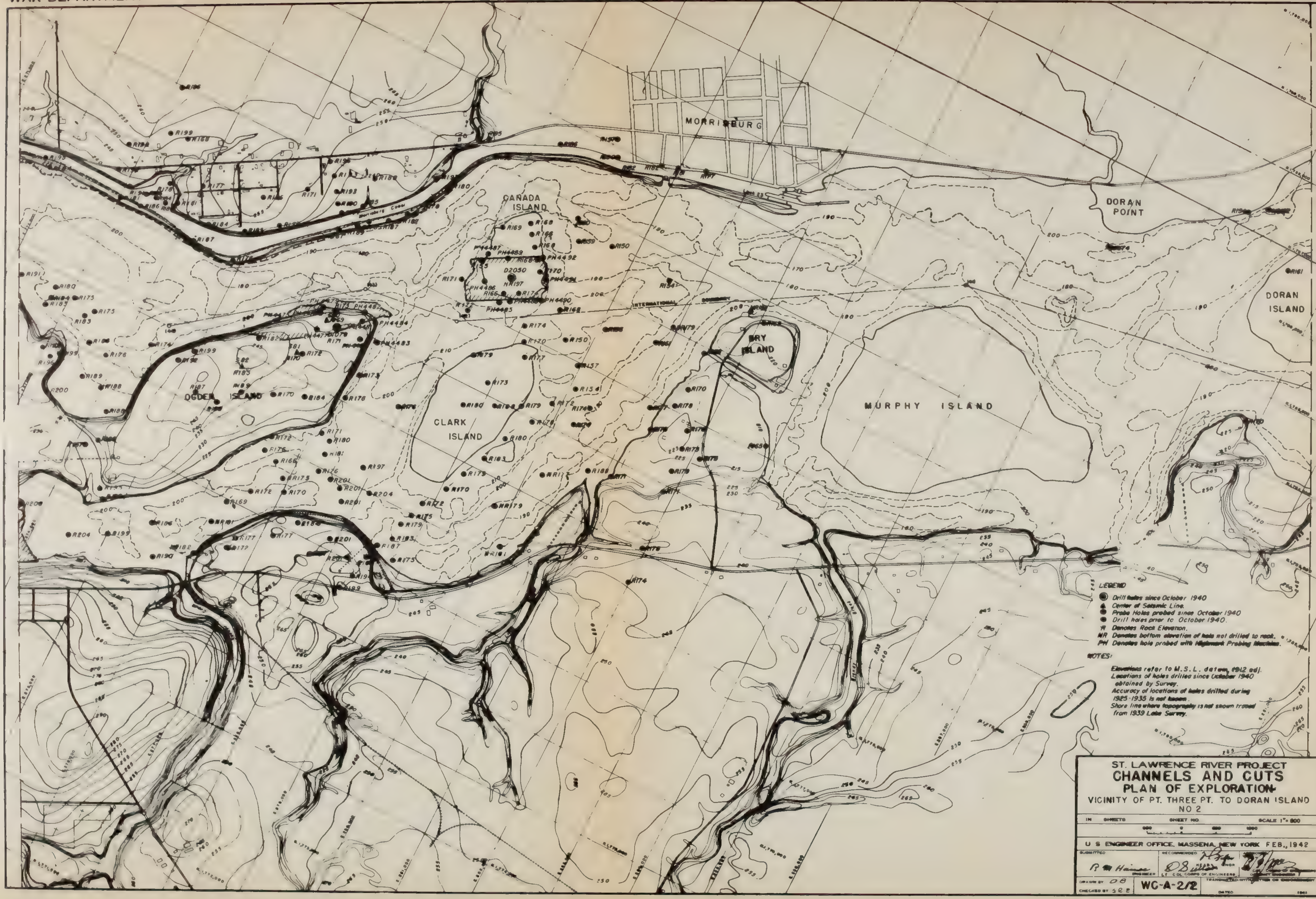
500 0 500 1000

U. S. ENGINEER OFFICE, MASSENA, NEW YORK FEB. 1942

SUBMITTED: R M Harnes ENGINEER
RECOMMENDED: HEAD ENGR. LT. COL. CORPS OF ENGINEERS
APPROVED: COL. CORPS OF ENGINEERS DISTRICT ENGINEER

DRAWN BY
CHECKED BY: GKB
FILE NO WC-A-2/1
TRANSMITTED WITH LETTER OF ENDORSEMENT
DATED

PLATE 17



LEGEND

- ◉ Drill holes since October 1940
- ▲ Center of Seismic Line.
- ● Probe Holes probed since October 1940
- ● Drill holes prior to October 1940.
- R Denotes Rock Elevation.
- NR Denotes bottom elevation of hole not drilled to rock.
- PH Denotes hole probed with Highmark Probing Machine.

NOTES:

Elevations refer to M.S.L. datum 1912 adj.
Locations of holes drilled since October 1940 obtained by Survey.
Accuracy of locations of holes drilled during 1925-1935 is not known.
Shore line where topography is not shown traced from 1939 Lake Survey.

ST. LAWRENCE RIVER PROJECT
CHANNELS AND CUTS
PLAN OF EXPLORATION
VICINITY OF PT. THREE PT. TO DORAN ISLAND
NO 2

IN SHEETS SHEET NO. SCALE 1" = 800

U S ENGINEER OFFICE, MASSENA, NEW YORK FEB., 1942

SUBMITTED R. M. Haines ENGINEER

RECOMMENDED D. S. [illegible] HEAD ENGR
LT. COL. CORPS OF ENGINEERS

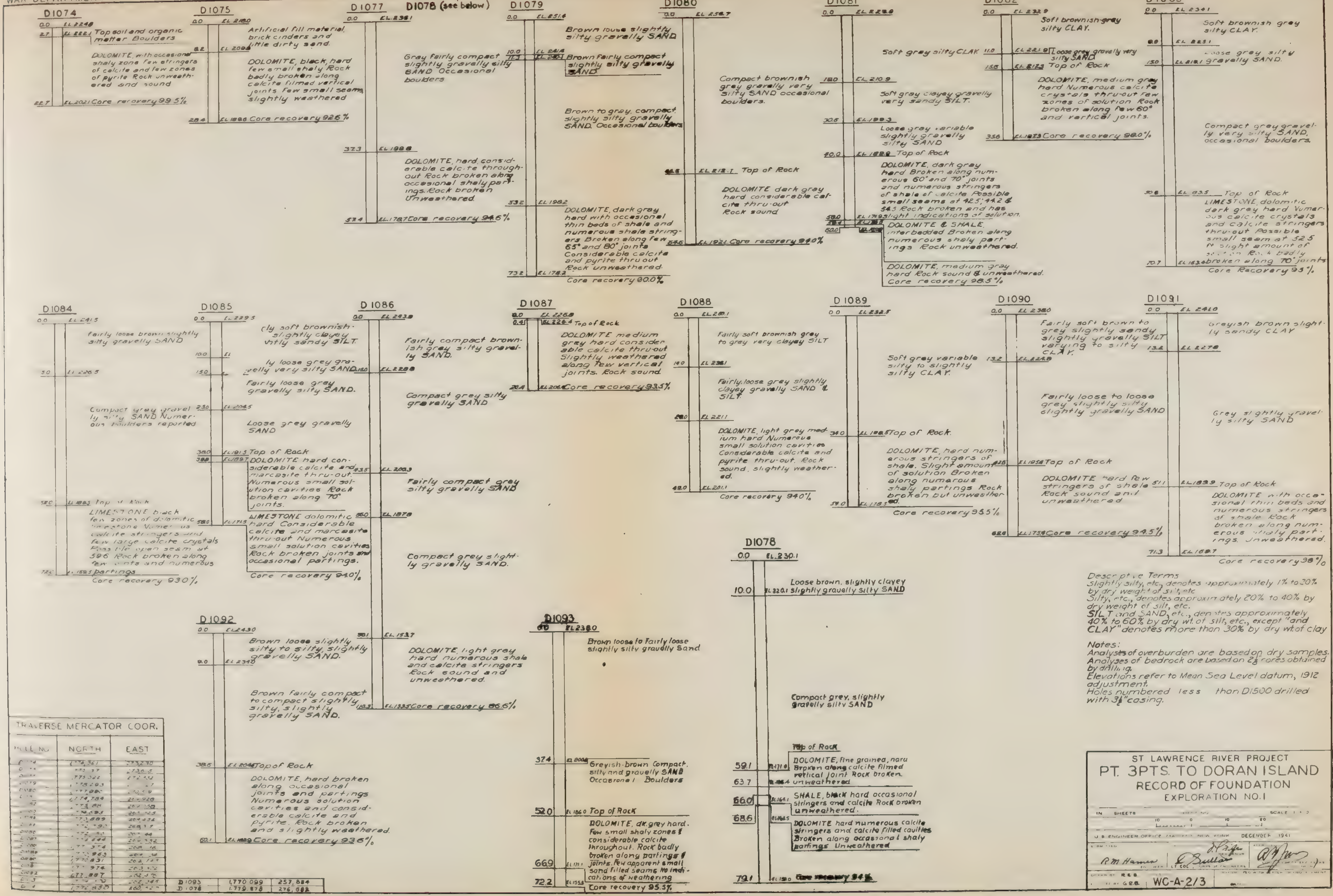
APPROVED

DRAWN BY D B
CHECKED BY S R E

WC-A-2/2

TRANSMITTED WITH LETTER OF ENDORSEMENT
DATED 1941

PLATE 18


D1074
0.0 EL 224.8
2.7 EL 222.1 Top soil and organic matter Boulders
DOLOMITE, with occasional shaly zone few stringers of calcite and few zones of pyrite Rock unweathered and sound
22.7 EL 202.1 Core recovery 99.5%
D1075
0.0 EL 218.0
Artificial fill material, brick cinders and little dirty sand.
8.2 EL 200.8
DOLOMITE, black, hard few small shaly Rock badly broken along calcite filmed vertical joints Few small seams slightly weathered
28.4 EL 188.6 Core recovery 92.6%
D1077
0.0 EL 236.1
Gray fairly compact slightly gravelly silty SAND Occasional boulders
37.3 EL 198.8
DOLOMITE, hard, considerable calcite throughout Rock broken along occasional shaly partings. Rock broken Unweathered.
57.4 EL 178.7 Core recovery 94.6%
D1078 (see below)
D1079
0.0 EL 251.4
Brown loose slightly silty gravelly SAND
10.0 EL 241.4
11.3 EL 240.1 Brown fairly compact slightly silty gravelly SAND
Brown to gray, compact, slightly silty gravelly SAND. Occasional boulders
53.2 EL 198.2
DOLOMITE, dark gray hard with occasional thin beds of shale and numerous shale stringers Broken along few 65° and 80° joints Considerable calcite and pyrite thru out Rock unweathered.
73.2 EL 178.2
Core recovery 80.0%
D1080
0.0 EL 256.7
Compact brownish grey gravelly very silty SAND occasional boulders.
44.6 EL 212.1 Top of Rock
DOLOMITE dark gray hard considerable calcite thru-out Rock sound
64.6 EL 192.1 Core recovery 94.0%
D1081
0.0 EL 228.9
Soft grey silty CLAY
18.0 EL 210.9
Soft gray clayey gravelly very sandy SILT.
30.6 EL 198.3
Loose gray variable slightly gravelly silty SAND
40.0 EL 188.9 Top of Rock
DOLOMITE, dark grey hard Broken along numerous 60° and 70° joints and numerous stringers of shale of calcite Possible small seams at 42.5; 44.2 & 54.5 Rock broken and has slight indications of solution.
58.0 EL 170.9
DOLOMITE & SHALE, interbedded Broken along numerous shaly partings Rock unweathered.
60.0
DOLOMITE, medium gray hard Rock sound & unweathered. Core recovery 98.5%
D1082
0.0 EL 232.9
Soft brownish-grey silty CLAY.
11.0 EL 221.9 Loose grey gravelly very silty SAND
15.6 EL 217.3 Top of Rock
DOLOMITE, medium grey hard Numerous calcite crystals thru-out few zones of solution Rock broken along few 60° and vertical joints.
35.6 EL 197.3 Core recovery 98.0%
D1083
0.0 EL 234.1
Soft brownish grey silty CLAY.
9.0 EL 225.1
Loose grey silty gravelly SAND.
15.0 EL 219.1
Compact grey gravelly very silty SAND, occasional boulders.
50.6 EL 183.5 Top of Rock
LIMESTONE, dolomitic dark grey hard Numerous calcite crystals and calcite stringers thru-out Possible small seam at 52.5 ft slight amount of solution Rock badly broken along 70° joints
70.7 EL 163.4
Core Recovery 95%
D1084
0.0 EL 241.5
Fairly loose brown slightly silty gravelly SAND
5.0 EL 236.5
Compact grey gravelly silty SAND Numerous boulders reported
52.0 EL 189.5 Top of Rock
LIMESTONE black few zones of dolomitic limestone Numerous calcite stringers and few large calcite crystals Possible open seam at 59.6 Rock broken along few joints and numerous partings
72.0 EL 169.5
Core recovery 93.0%
D1085
0.0 EL 229.5
Fairly soft brownish slightly clayey slightly sandy SILT.
10.0 EL
Fairly loose grey gravelly very silty SAND.
15.0
Fairly loose grey gravelly silty SAND.
25.0 EL 204.5
Loose grey gravelly SAND
38.0 EL 191.5 Top of Rock
39.8 EL 189.7 DOLOMITE hard considerable calcite and marcasite thru-out. Numerous small solution cavities Rock broken along 70° joints.
58.0 EL 171.5 LIMESTONE dolomitic hard Considerable calcite and marcasite thru-out Numerous small solution cavities Rock broken joints and occasional partings.
Core recovery 94.0%
D1086
0.0 EL 243.8
Fairly compact brownish grey silty gravelly SAND.
15.0 EL 228.8
Compact grey silty gravelly SAND
43.5 EL 200.3
Fairly compact grey silty gravelly SAND
55.0 EL 187.8
Compact grey slightly gravelly SAND.
90.1 EL 153.7
DOLOMITE, light gray hard numerous shale and calcite stringers Rock sound and unweathered.
110.3 EL 133.5 Core recovery 86.6%
D1087
0.0 EL 226.8
0.4 EL 226.4 Top of Rock
DOLOMITE medium grey hard considerable calcite thru-out Slightly weathered along few vertical joints. Rock sound.
20.4 EL 206.4 Core recovery 93.5%
D1088
0.0 EL 249.1
Fairly soft brownish grey to grey very clayey SILT
14.0 EL 235.1
Fairly loose grey slightly clayey gravelly SAND & SILT.
28.0 EL 221.1
DOLOMITE, light grey medium hard Numerous small solution cavities Considerable calcite and pyrite thru-out. Rock sound, slightly weathered.
48.0 EL 201.1
Core recovery 94.0%
D1089
0.0 EL 232.5
Soft grey variable silty to slightly silty CLAY.
34.0 EL 198.5 Top of Rock.
DOLOMITE, hard numerous stringers of shale. Slight amount of solution Broken along numerous shaly partings Rock broken but unweathered.
54.0 EL 178.5
Core recovery 95.5%
D1090
0.0 EL 238.0
Fairly soft brown to grey slightly sandy slightly gravelly SILT varying to silty CLAY.
13.2 EL 224.8
Fairly loose to loose grey slightly silty slightly gravelly SAND
42.6 EL 195.4 Top of Rock
DOLOMITE hard few stringers of shale Rock sound and unweathered
62.6 EL 175.4 Core recovery 94.5%
D1091
0.0 EL 241.0
Greyish brown slightly sandy CLAY
13.2 EL 227.8
Grey slightly gravelly silty SAND
51.1 EL 189.9 Top of Rock
DOLOMITE with occasional thin beds and numerous stringers of shale Rock broken along numerous shaly partings. Unweathered.
71.3 EL 169.7
Core recovery 98%
D1092
0.0 EL 243.0
Brown loose slightly silty to silty, slightly gravelly SAND.
9.0 EL 234.0
Brown fairly compact to compact slightly silty, slightly gravelly SAND.
38.6 EL 204.4 Top of Rock
DOLOMITE, hard broken along occasional joints and partings Numerous solution cavities and considerable calcite and pyrite. Rock broken and slightly weathered.
60.1 EL 182.9 Core recovery 93.6%
D1093
0.0 EL 238.0
Brown loose to Fairly loose slightly silty gravelly Sand
37.4 EL 200.6
Greyish-brown Compact, silty and gravelly SAND Occasional Boulders
52.0 EL 186.0 Top of Rock
DOLOMITE, dk. grey hard. Few small shaly zones & considerable calcite throughout. Rock badly broken along partings & joints. Few apparent small sand filled seams No indications of weathering
66.9 EL 171.1
72.2 EL 155.8
Core recovery 95.5%
D1078
0.0 EL 230.1
Loose brown, slightly clayey slightly gravelly silty SAND
10.0 EL 220.1
Compact grey, slightly gravelly silty SAND
Top of Rock
59.1 EL 171.0 DOLOMITE, fine grained, hard Broken along calcite filmed vertical joint Rock broken.
63.7 EL 166.4 unweathered
SHALE, black hard occasional stringers and calcite Rock broken unweathered.
66.0 EL 164.1
68.6 EL 161.5 DOLOMITE hard numerous calcite stringers and calcite filled cavities Broken along occasional shaly partings Unweathered
79.1 EL 151.0 Core recovery 94%

Descriptive Terms
Slightly silty, etc., denotes approximately 1% to 20% by dry weight of silt, etc.
Silty, etc., denotes approximately 20% to 40% by dry weight of silt, etc.
SILT and SAND, etc., denotes approximately 40% to 60% by dry wt. of silt, etc., except "and CLAY" denotes more than 30% by dry wt. of clay

Notes:
Analyses of overburden are based on dry samples.
Analyses of bedrock are based on $2\frac{1}{8}$" cores obtained by drilling.
Elevations refer to Mean Sea Level datum, 1912 adjustment.
Holes numbered less than D1500 drilled with $3\frac{1}{2}$" casing.

TRAVERSE MERCATOR COOR.

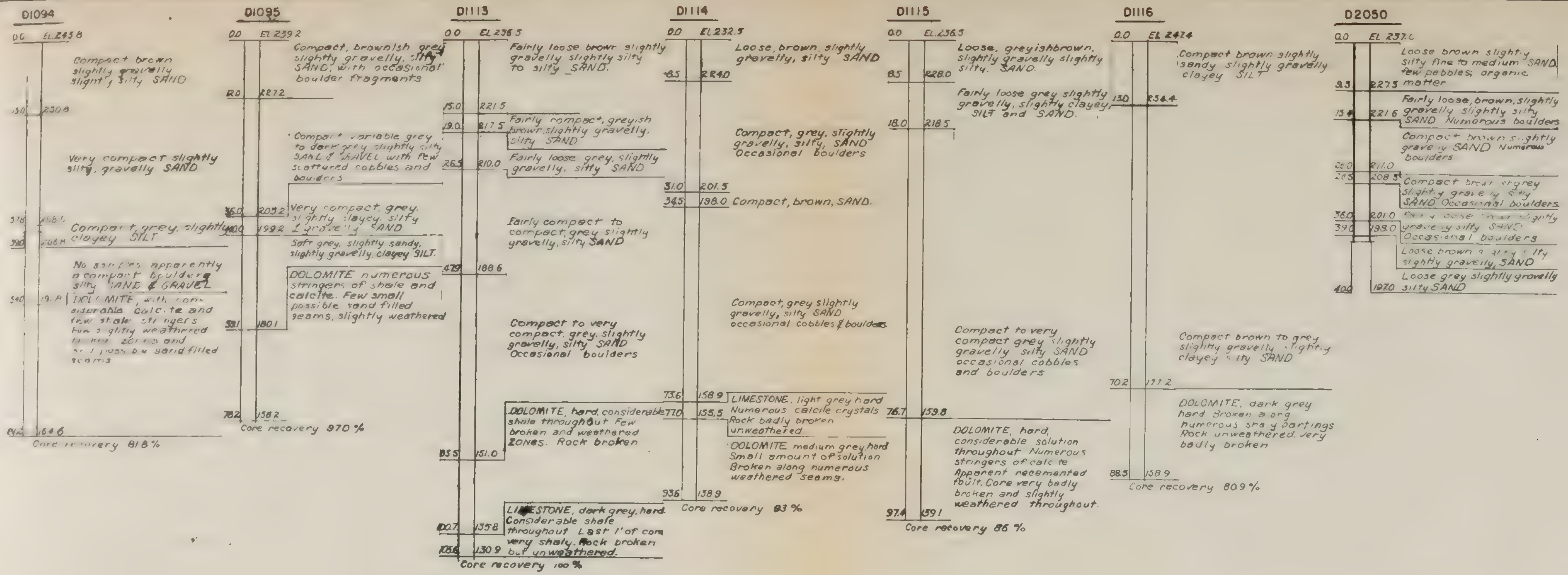
| HOLE NO. | NORTH | EAST |
|---|---|---|
| [illegible] | 1,774,361 | 273,270 |
| [illegible] | [illegible] | [illegible] |
| [illegible] | 1,775,022 | [illegible] |
| D1079 | [illegible] | [illegible] |
| D1080 | [illegible] | [illegible] |
| [illegible] | 1,774,784 | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| D1092 | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| D1093 | 1,770,099 | 257,884 |
| D1078 | 1,779,878 | 276,682 |

ST LAWRENCE RIVER PROJECT
PT. 3PTS. TO DORAN ISLAND
RECORD OF FOUNDATION
EXPLORATION NO. 1

IN SHEETS SCALE
10 0 10 20
U. S. ENGINEER OFFICE [illegible] NEW YORK DECEMBER 1941
R. M. Hamer
LT. COL., CORPS OF ENGINEERS
DRAWN BY R.E.B.
G.E.B.
WC-A-2/3

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY


D1094
0.0 EL.245.8
Compact brown slightly gravelly slightly silty SAND
13.0 230.8
Very compact slightly silty, gravelly SAND
37.8 208.0
Compact, grey, slightly clayey SILT
39.0 206.8
No samples apparently a compact bouldery silty SAND & GRAVEL
54.0 191.8
DOLOMITE, with considerable calcite and few shale stringers Few slightly weathered broken zones and and possible sand filled seams
81.2 164.6
Core recovery 81.8 %
D1095
0.0 EL.239.2
Compact, brownish grey slightly gravelly, silty SAND, with occasional boulder fragments
12.0 227.2
Compact variable grey to dark grey slightly silty SAND & GRAVEL with few scattered cobbles and boulders
36.0 203.2
Very compact, grey, slightly clayey, silty & gravelly SAND
40.0 199.2
Soft grey, slightly sandy, slightly gravelly, clayey SILT.
DOLOMITE numerous stringers of shale and calcite. Few small possible sand filled seams, slightly weathered
59.1 180.1
78.2 158.2
Core recovery 97.0 %
D1113
0.0 EL.236.5
Fairly loose brown slightly gravelly slightly silty to silty SAND.
15.0 221.5
19.0 217.5
Fairly compact, greyish brown slightly gravelly, silty SAND
26.5 210.0
Fairly loose grey, slightly gravelly, silty SAND
Fairly compact to compact, grey slightly gravelly, silty SAND
47.9 188.6
Compact to very compact, grey, slightly gravelly, silty SAND Occasional boulders
DOLOMITE, hard, considerable shale throughout Few broken and weathered zones. Rock broken
85.5 151.0
LIMESTONE, dark grey, hard. Considerable shale throughout Last 1' of core very shaly. Rock broken but unweathered.
100.7 135.8
105.6 130.9
Core recovery 100 %
D1114
0.0 EL.232.5
Loose, brown, slightly gravelly, silty SAND
8.5 224.0
Compact, grey, slightly gravelly, silty, SAND Occasional boulders
31.0 201.5
34.5 198.0
Compact, brown, SAND.
Compact, grey slightly gravelly, silty SAND occasional cobbles & boulders.
73.6 158.9
LIMESTONE, light grey hard Numerous calcite crystals Rock badly broken unweathered
77.0 155.5
DOLOMITE medium grey, hard Small amount of solution Broken along numerous weathered seams.
93.6 138.9
Core recovery 93 %
D1115
0.0 EL.236.5
Loose, greyishbrown, slightly gravelly slightly silty. SAND.
8.5 228.0
Fairly loose grey slightly gravelly, slightly clayey, SILT and SAND.
18.0 218.5
Compact to very compact grey slightly gravelly silty SAND occasional cobbles and boulders
76.7 159.8
DOLOMITE, hard, considerable solution throughout Numerous stringers of calcite Apparent recemented fault. Core very badly broken and slightly weathered throughout.
97.4 139.1
Core recovery 86 %
D1116
0.0 EL.247.4
Compact brown slightly sandy slightly gravelly clayey SILT
13.0 234.4
Compact brown to grey slightly gravelly slightly clayey silty SAND
70.2 177.2
DOLOMITE, dark grey hard Broken along numerous shaly partings Rock unweathered, very badly broken
88.5 158.9
Core recovery 80.9 %
D2050
0.0 EL.237.0
Loose brown slightly silty fine to medium SAND few pebbles; organic matter
9.5 227.5
Fairly loose, brown, slightly gravelly slightly silty SAND Numerous boulders
15.4 221.6
Compact brown slightly gravelly SAND Numerous boulders
26.0 211.0
28.5 208.5
Compact brown to grey slightly gravelly silty SAND Occasional boulders.
36.0 201.0
Fairly loose brown slightly gravelly silty SAND Occasional boulders
39.0 198.0
Loose brown & grey silty slightly gravelly, SAND
Loose grey slightly gravelly silty SAND
40.0 197.0

Notes:
Descriptive terms are given on Drwn'g File No. S-A-Z/21B.
Analyses of overburden are based on dry samples.
Analyses of bedrock are based on $2\frac{1}{8}$" cores obtained by drill
Elevations refer to Mean Sea Level datum, 1912 adjustment.
Holes numbered greater than D1500 drilled with $2\frac{1}{2}$" casing.
Holes numbered less than D1500 drilled with $3\frac{1}{2}$" casing.

| TRANSVERSE MERCATOR COOR | | |
|---|---|---|
| HOLE NO | NORTH | EAST |
| D1094 | 1,769,405 | 257,23[illegible] |
| [illegible]95 | 1,768,815 | 25[illegible],973 |
| [illegible]3 | 1,774,9[illegible]9 | 26[illegible],[illegible]45 |
| [illegible]4 | 1,772,850 | 260,585 |
| [illegible] | [illegible] | 25[illegible] |
| [illegible]6 | 1,776,[illegible] | 255,[illegible]90 |
| [illegible] | 1,778,630 | 258,5[illegible]0 |

ST LAWRENCE RIVER PROJECT
# PT. 3PTS. TO DORAN ISLAND
## RECORD OF FOUNDATION
## EXPLORATION NO 2

IN SHEETS SHEET NO SCALE 1" = 10'

10 0 10 20

U S ENGINEER OFFICE MASSENA NEW YORK DECEMBER 1941

SUBMITTED: R M Hames, ENGINEER
RECOMMENDED: H Fisher, HEAD ENGR; B Bullard, LT COL., CORPS OF ENGINEERS
APPROVED: CORPS OF ENGINEERS, DISTRICT ENGINEER

DRAWN BY MAB
CHECKED BY G.R.B.
FILE NO WC-A-2/4
TRANSMITTED WITH LETTER OR ENDORSEMENT
DATED

PLATE 20

ST. LAWRENCE RIVER

PROBING RESULTS - OGDEN ISLAND

| Probing No. Coordinates and Surface Elevation | Depth in Feet | Blows per Foot | Feet per Hour | Samples No. | Samples Depth | Description of Samples |
|---|---|---|---|---|---|---|
| PH-4450 | | | | | | |
| N. 1,773,308 | 0-12 | Water | | | | |
| E. 263,480 | 12-13 | 11 | 330 | | | |
| EL. 223.3 | 13-14 | 49 | 82 | | | |
| | 14-17 | 73 | 49 | | | |
| | 17-17.6 | 120 | 30 | | | |
| | Refusal | | | | | |
| PH-4451 | | | | | | |
| N. 1,773,512 | 0-3 | 3 | 1200 | | | Very rocky |
| E. 263,732 | 3-4 | 11 | 330 | | | bottom |
| EL. 223.3 | 4-6 | 31 | 116 | | | |
| | 6-9 | 118 | 31 | | | |
| | 9-11 | 51 | 71 | | | |
| | 11-13 | 98 | 37 | | | |
| | 13-13.6 | | | | | |
| | Refusal | | | | | |
| PH-4452 | | | | | | |
| N. 1,773,652 | 0-13 | Water | | | | Very rocky |
| E. 263,587 | 13-14 | 56 | 64 | | | bottom |
| EL. 223.2 | 14-16 | 108 | 33 | | | |
| | 16-17 | [illegible] | 42 | | | |
| | 17-17.5 | 224 | 16 | | | |
| | Refusal | | | | | |
| PH-4453 | | | | | | |
| N. 1,773,873 | 0-4 | 11 | 330 | | | Some boulders in |
| E. 264,180 | 4-6 | 33 | 110 | | | this area |
| EL. 227.0 | 6-7 | 209 | 17 | | | |
| | No Refusal | | | | | |
| PH-4454 | | | | | | |
| N. 1,774,301 | 0-12.5 | Water | | | | Many boulders |
| E. 263,834 | Refusal | | | | | on bottom |
| EL. 222.9 | | | | | | |
| PH-4455 | 0-3 | 8 | 450 | | | |
| N. 1,774,251 | 3-6 | 125 | 29 | | | Some boulders |
| E. 264,646 | No Refusal | | | | | in this area |
| EL. 238.9 | | | | | | |
| PH-4456 | | | | | | |
| N. 1,774,640 | 0-26 | Water | | | | |
| E. 264,332 | | | | | | |
| EL. 222.5 | | | | | | |
| PH-4457 | | | | | | |
| N. 1,774,565 | 0-2 | 4 | 900 | | | Some boulders |
| E. 265,035 | 2-4 | 18 | 200 | | | in this area |
| EL. 243.2 | 4-5 | 73 | 49 | | | |
| | 5-6 | 228 | 16 | | | |
| | No Refusal | | | | | |
| PH-4458 | | | | | | |
| N. 1,774,915 | 0-14.9 | Water | | | | |
| E. 264,752 | 14.9-17 | 45 | 80 | | | |
| EL. 222.1 | 17-17.4 | 190 | 19 | | | |
| | Refusal | | | | | |
| PH-4459 | | | | | | |
| N. 1,774,759 | 0-2 | 7 | 515 | | | Some boulders |
| E. 265,496 | 2-8 | 4 | 900 | | | in this area |
| EL. 232.2 | 8-14 | 130 | 28 | | | |
| | 14-16 | 65 | 55 | | | |
| | 16-16.6 | 330 | 11 | | | |
| | Refusal | | | | | |
| PH-4460 | | | | | | |
| N. 1,774,931 | 0-1.2 | Water | | | | |
| E. 265,390 | 1.2-12 | 1 | 3600 | S1 | 7.6 | |
| EL. 221.9 | 12-17 | 10 | 360 | | to 8.2 | Silty CLAY |
| | 17-18.4 | 90 | 40 | | | |
| | Refusal | | | | | |
| PH-4461 | | | | | | |
| N. 1,774,953 | 0-2 | 11 | 333 | | | Many large |
| E. 265,957 | 2-5 | 35 | 104 | | | boulders in |
| EL. 223.4 | 5-6 | 92 | 39 | | | this area |
| | 6-8 | 62 | 58 | | | |
| | 8-9 | 153 | 24 | | | |
| | Refusal | | | | | |
| PH-4462 | | | | | | |
| N. 1,775,069 | 0-8.8 | Water | | | | |
| E. 266,233 | 8.8-13 | 1 | 3600 | | | |
| EL. 221.3 | 13-24 | 8 | 450 | S1 | 14.4 | |
| | 24-24.3 | 80 | 45 | | to 15.0 | Silty SAND |
| | Refusal | | | | | |
| PH-4463 | | | | | | |
| N. 1,775,400 | 0-5.8 | Water | | | | |
| E. 268,380 | 5.8-10 | 5 | 721 | S1 | 10.0 | |
| EL. 221.7 | 10-12 | 53 | 69 | | to10.6 | Silty CLAY |
| | 12-13 | 157 | 23 | | | |
| | 13-13.2 | 500 | 7 | | | |
| | No Refusal | | | | | |
| PH-4464 | | | | | | |
| N. 1,775,700 | 0-2.8 | Water | | | | |
| E. 268,500 | 2.8-10 | 1 | 3600 | | | |
| EL. 221.7 | 10-17 | 5 | 721 | S1 | 10.6 | Sandy SILT |
| | 17-31.9 | 11 | 330 | S2 | 17.6 | SILT & CLAY |
| | Refusal | | | S3 | 23.6 | Silty CLAY |
| | | | | S4 | 30.6 | Silty CLAY |
| PH-4465 | | | | | | |
| N. 1,777,650 | 0-1.2 | Water | | | | Bed Rock visable |
| E. 269,750 | | | | | | |
| EL. 219.5 | | | | | | |
| PH-4466 | | | | | | |
| N. 1,777,967 | 0-3 | 15 | 240 | | | |
| E. 270,259 | 3-5 | 80 | 45 | | | |
| EL. 242.8 | 5-7 | 104 | 35 | | | |
| | 7-8 | 222 | 17 | | | |
| | 8-8.1 | 340 | 11 | | | |
| | Refusal | | | | | |
| PH-4467 | | | | | | |
| N. 1,778,179 | 0-2.8 | 20 | 180 | | | |
| E. 270,127 | Refusal | | | | | |
| EL. 218.7 | | | | | | |
| PH-4468 | | | | | | |
| N. 1,778,126 | 0-2 | 8 | 451 | | | |
| E. 270,514 | 2-3 | 61 | 59 | | | |
| EL. 249.0 | 3-4 | 24 | 150 | | | |
| | 4-7 | 98 | 37 | S1 | 6.0 | |
| | 7-7.3 | 310 | 12 | | to6.4 | Sandy SILT |
| | Refusal | | | | | |
| PH-4469 | | | | | | |
| N. 1,778,330 | 0-3 | 12 | 300 | | | Many boulders in |
| E. 270,387 | 3-4 | 120 | 30 | | | this area |
| EL. 218.2 | 4-4.5 | 206 | 17 | | | |
| | Refusal | | | | | |
| PH-4470 | | | | | | |
| N. 1,778,284 | 0-2 | 8 | 450 | | | |
| E. 270,769 | 2-4 | 65 | 55 | | | |
| EL. 251.3 | 4-4.7 | 290 | 12 | | | |
| | No Refusal | | | | | |
| PH-4471 | | | | | | |
| N. 1,778,497 | 0-3 | 4 | 900 | | | Many boulders in |
| E. 270,636 | 3-4 | 60 | 60 | | | this area |
| EL. 217.8 | 4-5 | 119 | 30 | | | |
| | 5-5.6 | 350 | 10 | | | |
| | No Refusal | | | | | |
| PH-4472 | | | | | | |
| N. 1,778,443 | 0-4 | 13 | 280 | S1 | 7.0 | |
| E. 271,023 | 4-7 | 132 | 27 | | to7.4 | Silty SAND |
| EL. 243.3 | 7-9 | 86 | 42 | | | |
| | 9-9.1 | 390 | 9 | | | |
| | Refusal | | | | | |
| PH-4473 | | | | | | |
| N. 1,778,602 | 0-2 | 4 | 900 | | | |
| E. 271,278 | 2-3 | 65 | 55 | | | |
| EL. 217.0 | 3-3.4 | 190 | 19 | | | |
| | Refusal | | | | | |
| PH-4474 | Water too swift for probing | | | | | |
| N. 1,779,524 | | | | | | |
| E. 275,560 | | | | | | |
| EL 214.1 | | | | | | |
| PH-4475 | | | | | | |
| N. 1,779,600 | 0-3 | 6 | 600 | | | Many boulders in |
| E. 275,850 | 3-4 | 67 | 54 | | | this area |
| EL. 215.6 | 4-6 | 166 | 22 | | | |
| | 6-7 | 224 | 16 | | | |
| | No Refusal | | | | | |
| PH-4476 | | | | | | |
| N. 1,779,794 | Water too swift for probing | | | | | |
| E. 275,800 | | | | | | |
| EL. 214.1 | | | | | | |
| PH-4477 | | | | | | |
| N. 1,779,751 | 0-1 | 5 | 720 | | | Some boulders & |
| E. 276,431 | 1-2 | 23 | 157 | | | large trees in |
| EL. 233.9 | 2-3 | 113 | 32 | | | this area |
| | 3-5 | 262 | 14 | | | |
| | No Refusal | | | | | |
| PH-4478 | | | | | | |
| N. 1,779,993 | 0-2 | 18 | 200 | | | Some boulders & |
| E. 275,367 | 2-3 | 103 | 35 | | | large trees in |
| EL. 227.1 | 3-4 | 172 | 21 | | | this area |
| | 4-6 | 233 | 15 | | | |
| | No Refusal | | | | | |

FILE NO. WC-A-2/5

PLATE - 21

# ST. LAWRENCE RIVER

## PROBING RESULTS - OGDEN ISLAND

| Probing No. coordinates and Surface Elevation | Depth in Feet | Blows per Foot | Feet per Hour | Samples No. | Samples Depth | Description of Samples |
|---|---|---|---|---|---|---|
| **PB-4479** | | | | | | |
| N. 1,780,070 | 0-3 | 3 | 1200 | | | Many boulders on |
| E. 276,348 | 3-4 | 24 | 150 | | | shore line |
| EL. 213.2 | 4-5 | 70 | 51 | | | |
| | 5-5.7 | 29 | 124 | | | |
| | No Refusal | | | | | |
| **PB-4480** | | | | | | |
| N. 1,779,903 | 0-3 | 8 | 450 | | | A few large |
| E. 277,011 | 3-8 | 70 | 51 | | | boulders in this |
| EL. 235.0 | 8-10.7 | 140 | 25 | | | area |
| | Refusal at 10.6 on 3rd attempt | | | | | |
| **PB-4481** | | | | | | |
| N. 1,780,145 | 0-2 | 4 | 900 | | | |
| E. 276,948 | 2-4 | 20 | 180 | | | |
| EL. 22[illegible] | 4-5 | 53 | 88 | | | |
| | 5-6.3 | 250 | 14 | | | |
| | No Refusal | | | | | |
| **PB-4482** | | | | | | |
| N. 1,780,264 | 0-2 | 1 | 3600 | | | |
| E. 276,917 | 2-3 | 36 | 100 | | | |
| EL. 213.4 | 3-5 | 80 | 45 | | | |
| | 5-6.5 | 275 | 13 | | | |
| | No Refusal | | | | | |
| **PB-4483** | | | | | | |
| N. 1,779,964 | 0-13.6 | Water | | | | |
| E. 277,298 | 13.6-15 | 21 | 170 | | | |
| EL. 211.0 | 15-16.5 | 100 | 36 | | | |
| | Refusal | | | | | |
| **PB-4484** | | | | | | |
| N. 1,780,188 | 0-2 | 4 | 900 | S | 6.4 | SAND |
| E. 277,114 | 2-6 | 33 | 109 | | | |
| EL. 212.2 | 6-7 | 89 | 40 | | | |
| | 7-7.4 | 275 | 13 | | | |
| | Refusal | | | | | |

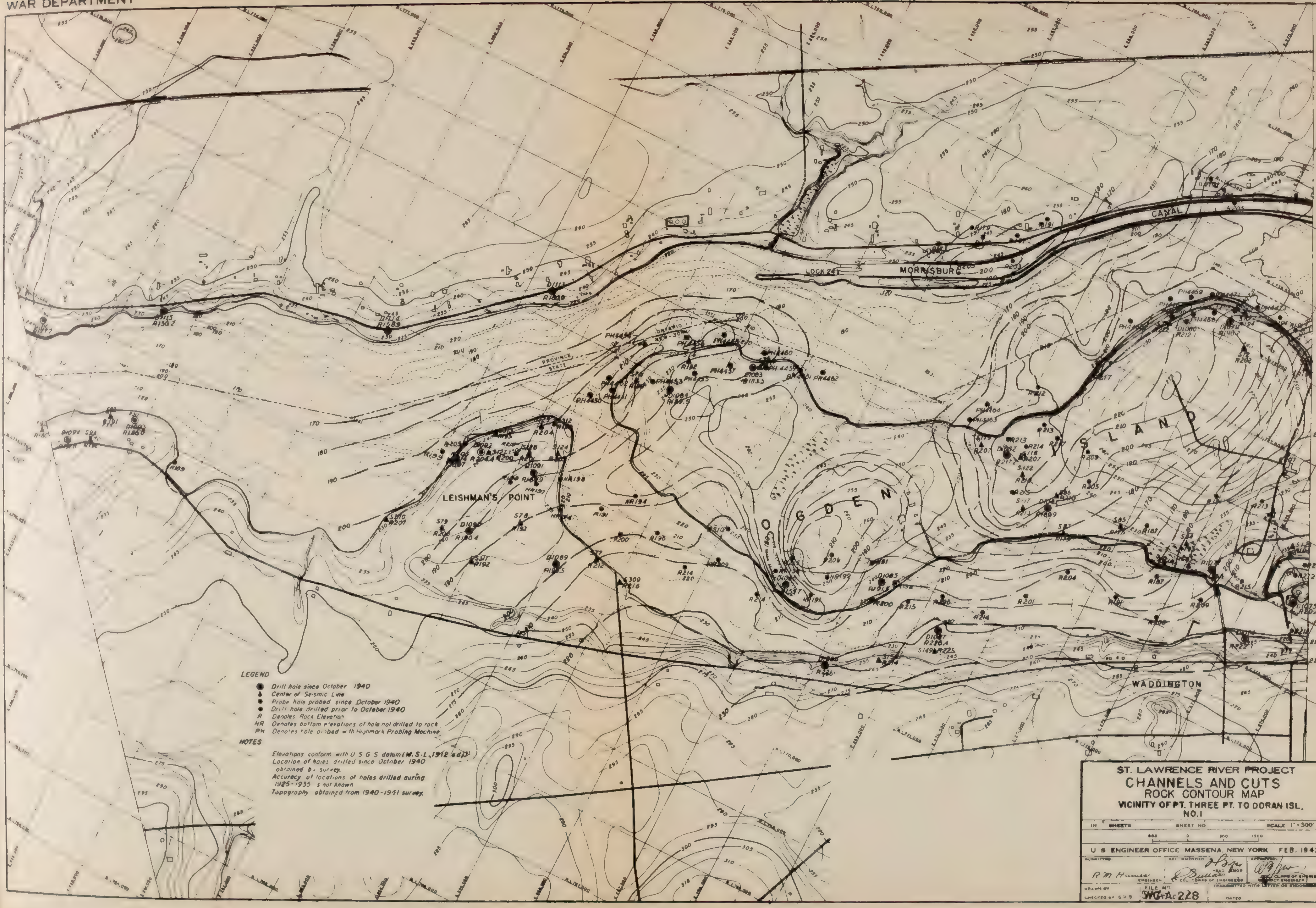
ST. LAWRENCE RIVER

PROBING RESULTS - CANADA ISLAND

| Probing Coordinates and Surface Elevation | Depth in Feet | Blows per Foot | Feet per Hour | Samples No. | Samples Depth | Description of Samples |
|---|---|---|---|---|---|---|
| PE-4485 | | | | | | |
| N. 1,781,268 | 0-3 | [illegible] | 515 | S1 | 6.6 | Silty SAND |
| E. 278,560 | 3-6 | 15 | 240 | S2 | 12.6 | Silty SAND |
| EL. 212.6 | 6-16 | 28 | 130 | S3 | 19.6 | Silty SAND |
| | 16-21 | 40 | 90 | | | |
| | 21-21.9 | 180 | 20 | | | Many boulders in |
| | No Refusal | | | | | this area |
| PE-4486 | | | | | | |
| N. 1,781,430 | 0-2 | 4 | 900 | | | Many boulders & |
| E. 278,223 | 2-10 | 65 | 55 | | | cobbles in this |
| EL. 213.9 | 10-12 | 175 | 20 | | | area |
| | No Refusal | | | | | |
| PE-4487 | | | | | | |
| N. 1,781,089 | 0-2 | 9 | 400 | | | Very many cobbles & |
| E. 278,070 | 2-4.6 | 120 | 30 | | | boulders in this |
| EL. 214.4 | Refusal | | | | | area |
| PE-4488 | | | | | | |
| N. 1,781,340 | 0-3 | 8 | 450 | | | Some cobbles in |
| E. 278,692 | 3-15 | 40 | 90 | | | this area |
| EL. 213.8 | 15-17 | 75 | 48 | S1 | 6.6 | Silty SAND |
| | 17-18.5 | 150 | 24 | S2 | 12.6 | Silty SAND |
| | Refusal | | | | | |
| PE-4489 | | | | | | |
| N. 1,781,870 | 0-2 | 10 | 360 | | | |
| E. 278,410 | 2-3 | 43 | 84 | | | |
| EL. 242.4 | 3-4 | 226 | 16 | | | |
| | No Refusal at 4.0 on 4th attempt | | | | | |
| PE-4490 | | | | | | |
| N. 1,781,551 | 0-4 | Water | | S1 | 9.0 | |
| E. 279,089 | 4-7 | 4 | 900 | | to9.6 | Silty SAND |
| EL. 211.4 | 7-11 | 14 | 260 | | | |
| | 11-12 | 43 | 84 | | | |
| | 12-13.1 | 200 | 18 | | | |
| | Refusal | | | | | |
| PE-4491 | | | | | | |
| N. 1,781,844 | 0-1.5 | Water | | S1 | 10.0 | |
| E. 279,001 | 1.5-2 | 1 | 3600 | | to10.6 | Silty CLAY |
| EL. 211.2 | 2-10 | 7 | 515 | S2 | 15.0 | |
| | 10-15 | 13 | 280 | | to15.6 | Silty SAND |
| | 15-17 | 65 | 55 | | | |
| | 17-22 | 40 | 90 | | | |
| | 22-23.2 | 300 | 12 | | | |
| | No Refusal | | | | | |
| PE-4492 | | | | | | |
| N. 1,782,095 | 0-1.8 | Water | | | | |
| E. 278,833 | 1.8-4 | 1 | 3600 | S1 | 10.0 | |
| EL. 211.4 | 4-6 | 4 | 900 | | to10.6 | Silty CLAY |
| | 6-14 | 10 | 360 | | | |
| | 14-17 | 60 | 60 | S2 | 15.0 | |
| | 17-18 | 218 | 17 | | to15.4 | Silty SAND |
| | No Refusal | | | | | |

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



LEGEND

- ● Drill hole since October 1940
- ▲ Center of Seismic Line
- ● Probe hole probed since October 1940
- ● Drill hole drilled prior to October 1940
- R Denotes Rock Elevation
- NR Denotes bottom elevations of hole not drilled to rock
- PH Denotes hole probed with Highmark Probing Machine

NOTES

Elevations conform with U S G S datum (M.S.L., 1912 adj.)
Location of holes drilled since October 1940 obtained by survey.
Accuracy of locations of holes drilled during 1925-1935 is not known
Topography obtained from 1940-1941 survey.

ST. LAWRENCE RIVER PROJECT
CHANNELS AND CUTS
ROCK CONTOUR MAP
VICINITY OF PT. THREE PT. TO DORAN ISL.
NO.1

IN SHEETS SHEET NO SCALE 1" = 300'

500 0 500 1000

U S ENGINEER OFFICE MASSENA, NEW YORK FEB. 1942

SUBMITTED: R M Haines ENGINEER

RECOMMENDED: HEAD ENGR. LT. COL. CORPS OF ENGINEERS

APPROVED: CORPS OF ENGINEERS DISTRICT ENGINEER

DRAWN BY

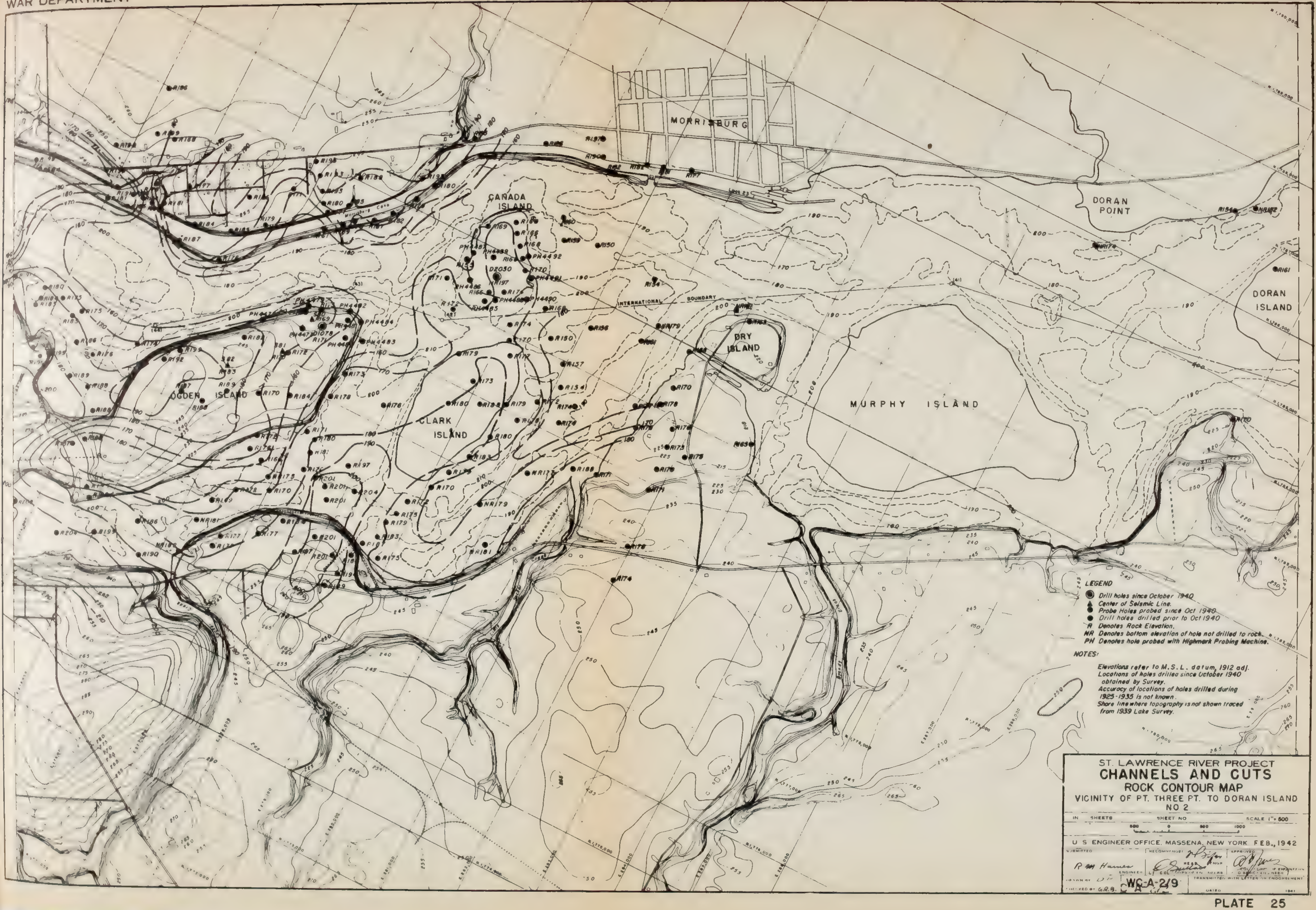
CHECKED BY G P B

FILE NO. WC-A-228

TRANSMITTED WITH LETTER OR ENDORSEMENT

DATED

PLATE 24



LEGEND

◉ Drill holes since October 1940
▲ Center of Seismic Line.
● Probe Holes probed since Oct 1940
● Drill holes drilled prior to Oct 1940
R Denotes Rock Elevation.
NR Denotes bottom elevation of hole not drilled to rock.
PH Denotes hole probed with Highmark Probing Machine.

NOTES:

Elevations refer to M.S.L. datum, 1912 adj.
Locations of holes drilled since October 1940 obtained by Survey.
Accuracy of locations of holes drilled during 1925-1935 is not known.
Shore line where topography is not shown traced from 1939 Lake Survey.

ST. LAWRENCE RIVER PROJECT
**CHANNELS AND CUTS**
ROCK CONTOUR MAP
VICINITY OF PT. THREE PT. TO DORAN ISLAND
NO 2

IN SHEETS SHEET NO SCALE 1" = 500

500 0 500 1000

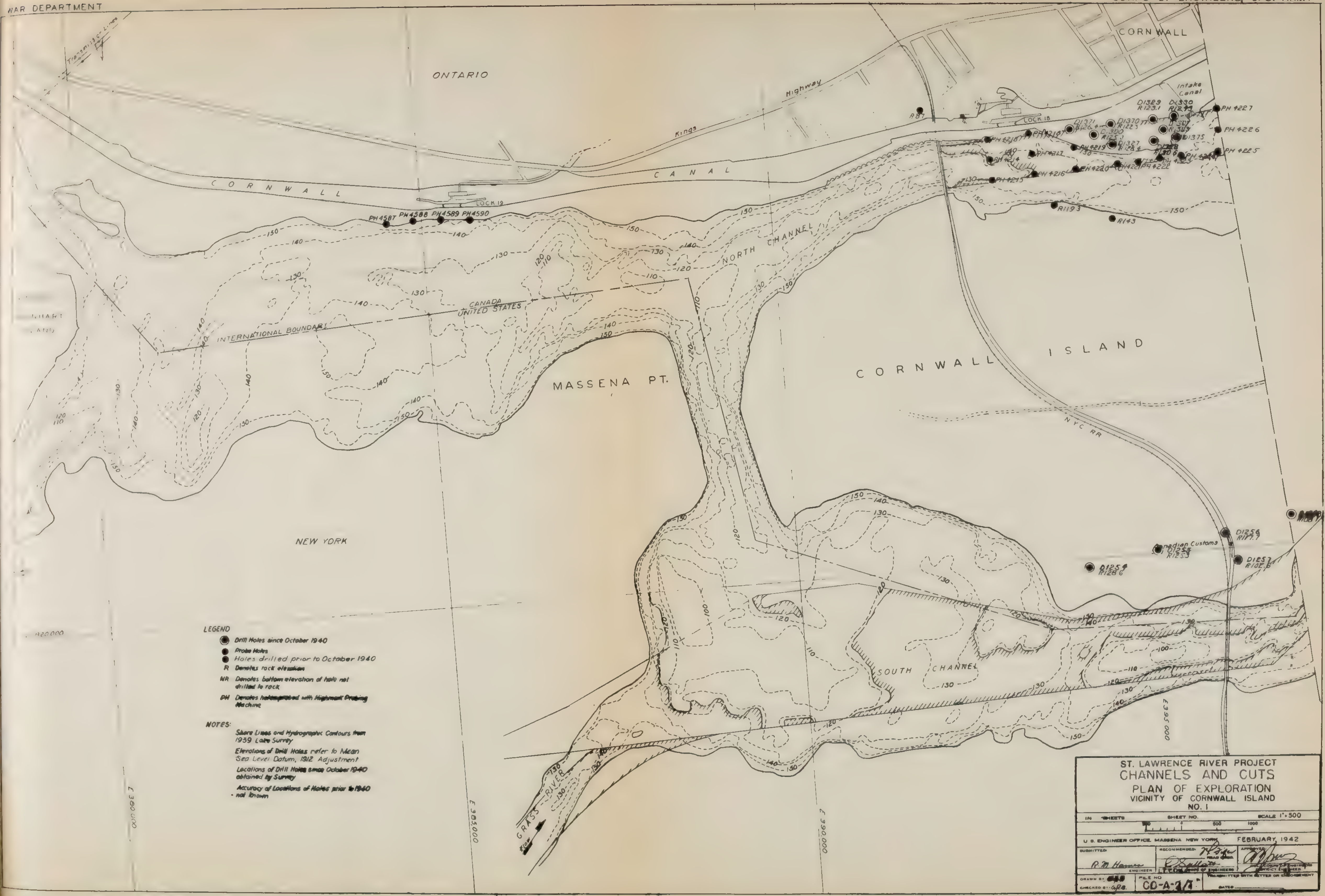
U S ENGINEER OFFICE, MASSENA, NEW YORK FEB., 1942

SUBMITTED R M Hames ENGINEER
RECOMMENDED HEAD ENGR LT COL CORPS OF ENGINEERS
APPROVED COL CORPS OF ENGINEERS DISTRICT ENGINEER
DRAWN BY D.F.
CHECKED BY G.R.B.
WC-A-2/9
TRANSMITTED WITH LETTER OR ENDORSEMENT
DATED 1941

PLATE 25

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



LEGEND

- ◉ Drill Holes since October 1940
- ● Probe Holes
- ● Holes drilled prior to October 1940
- R Denotes rock elevation
- NR Denotes bottom elevation of hole not drilled to rock
- PH Denotes hole probed with Highmark Probing Machine

NOTES:

Shore Lines and Hydrographic Contours from 1939 Lake Survey

Elevations of Drill Holes refer to Mean Sea Level Datum, 1912 Adjustment

Locations of Drill Holes since October 1940 obtained by Survey

Accuracy of Locations of Holes prior to 1940 not known

ST. LAWRENCE RIVER PROJECT
CHANNELS AND CUTS
PLAN OF EXPLORATION
VICINITY OF CORNWALL ISLAND
NO. 1

IN ~~SHEETS~~ SHEET NO. SCALE 1"=500

500 0 500 1000

U. S. ENGINEER OFFICE, MASSENA NEW YORK FEBRUARY, 1942

SUBMITTED: R. M. Hanna ENGINEER

RECOMMENDED: HEAD CHECK

LT. COL. CORPS OF ENGINEERS

APPROVED: CORPS OF ENGINEERS DISTRICT ENGINEER

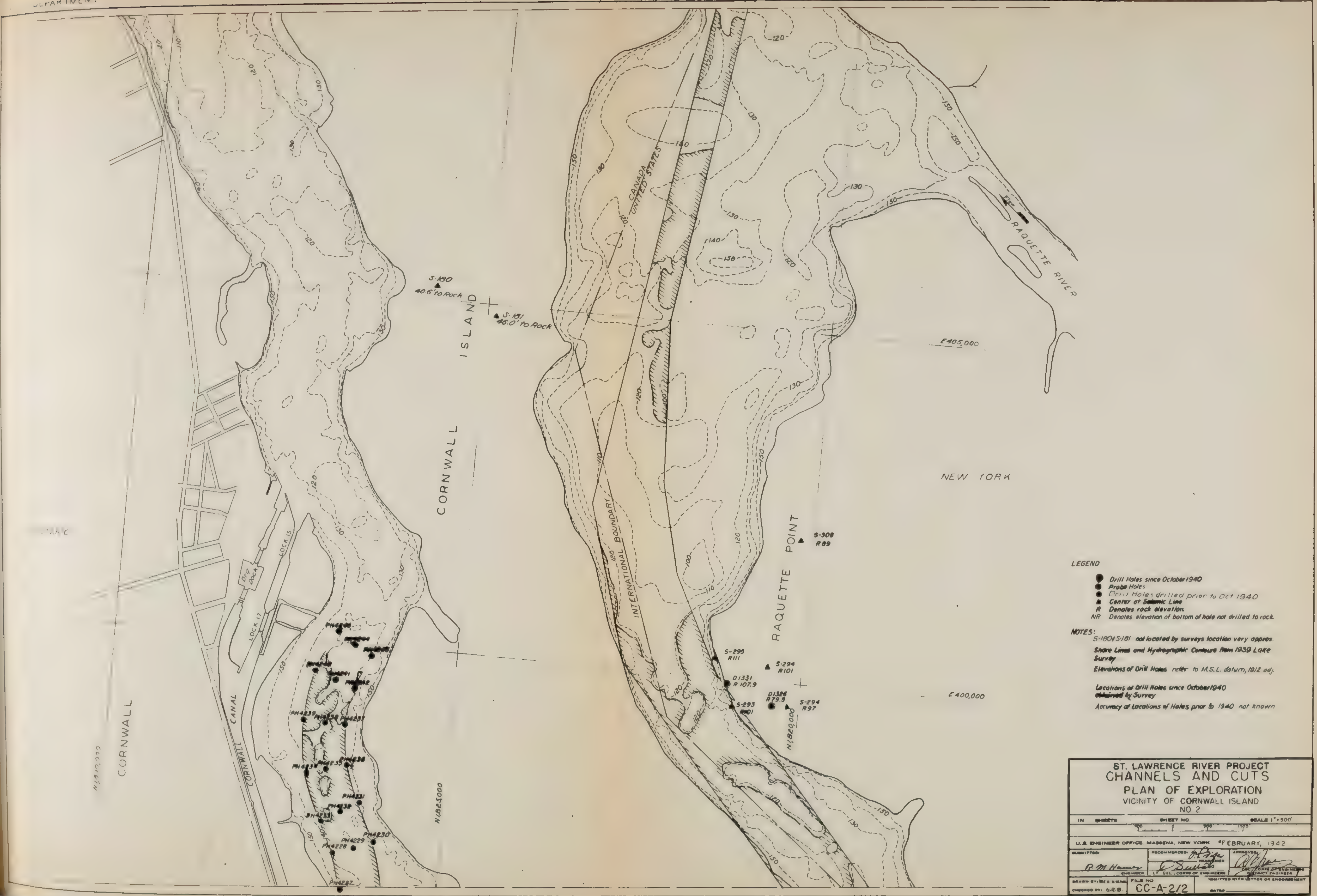
TRANSMITTED WITH LETTER OR ENDORSEMENT

DATED

DRAWN BY:

CHECKED BY: G.P.S.

FILE NO CO-A-2/4



LEGEND

- ● *Drill Holes since October 1940*
- ● *Probe Holes*
- ● *Drill Holes drilled prior to Oct 1940*
- ▲ *Center of Seismic Line*
- R *Denotes rock elevation.*
- NR *Denotes elevation of bottom of hole not drilled to rock.*

NOTES:

*S-180 & S-181 not located by surveys location very approx.*

*Shore Lines and Hydrographic Contours from 1939 Lake Survey*

*Elevations of Drill Holes refer to M.S.L. datum, 1912 adj.*

*Locations of Drill Holes since October 1940 obtained by Survey*

*Accuracy of Locations of Holes prior to 1940 not known*

ST. LAWRENCE RIVER PROJECT
CHANNELS AND CUTS
PLAN OF EXPLORATION
VICINITY OF CORNWALL ISLAND
NO 2

IN SHEETS SHEET NO. SCALE 1" = 500'

U.S. ENGINEER OFFICE, MASSENA, NEW YORK 4 FEBRUARY, 1942

SUBMITTED: R M Harvey ENGINEER

RECOMMENDED: HEAD ENGINEER

LT. COL., CORPS OF ENGINEERS

APPROVED: COL., CORPS OF ENGINEERS DISTRICT ENGINEER

DRAWN BY: RES & EMAB

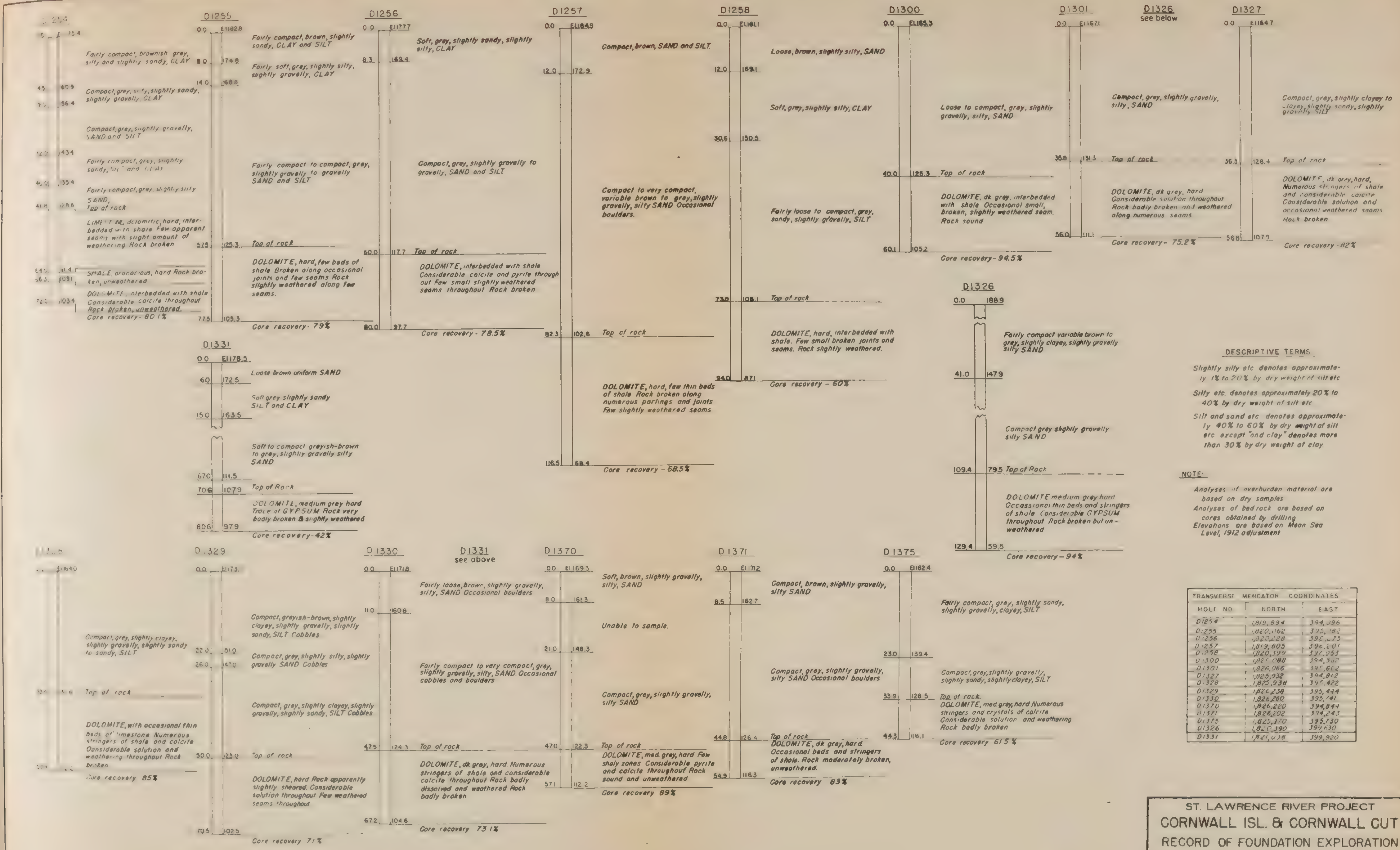
CHECKED BY: G.R.B.

FILE NO CC-A-2/2

SUBMITTED WITH LETTER OR ENDORSEMENT DATED ______

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



**D1254**

Fairly compact, brownish grey, silty and slightly sandy, CLAY

Compact, grey, silty, slightly sandy, slightly gravelly, CLAY

Compact, grey, slightly gravelly, SAND and SILT

Fairly compact, grey, slightly sandy, SILT and CLAY

Fairly compact, grey, slightly silty SAND,

Top of rock

LIMESTONE, dolomitic, hard, interbedded with shale Few apparent seams with slight amount of weathering Rock broken

SHALE, arenacious, hard Rock broken, unweathered

DOLOMITE, interbedded with shale Considerable calcite throughout Rock broken, unweathered.

Core recovery - 80.1%

**D1255**

Fairly compact, brown, slightly sandy, CLAY and SILT

Fairly soft, grey, slightly silty, slightly gravelly, CLAY

Fairly compact to compact, grey, slightly gravelly to gravelly SAND and SILT

Top of rock

DOLOMITE, hard, few beds of shale Broken along occasional joints and few seams Rock slightly weathered along few seams.

Core recovery - 79%

**D1256**

Soft, grey, slightly sandy, slightly silty, CLAY

Compact, grey, slightly gravelly to gravelly, SAND and SILT

Top of rock

DOLOMITE, interbedded with shale Considerable calcite and pyrite throughout Few small slightly weathered seams throughout Rock broken

Core recovery - 78.5%

**D1257**

Compact, brown, SAND and SILT.

Compact to very compact, variable brown to grey, slightly gravelly, silty SAND Occasional boulders.

Top of rock

DOLOMITE, hard, few thin beds of shale Rock broken along numerous partings and joints Few slightly weathered seams

Core recovery - 68.5%

**D1258**

Loose, brown, slightly silty, SAND

Soft, grey, slightly silty, CLAY

Fairly loose to compact, grey, sandy, slightly gravelly, SILT

Top of rock

DOLOMITE, hard, interbedded with shale. Few small broken joints and seams. Rock slightly weathered.

Core recovery - 60%

**D1300**

Loose to compact, grey, slightly gravelly, silty, SAND

Top of rock

DOLOMITE, dk grey, interbedded with shale Occasional small, broken, slightly weathered seam. Rock sound

Core recovery - 94.5%

**D1301**

Compact, grey, slightly gravelly, silty, SAND

Top of rock

DOLOMITE, dk grey, hard Considerable solution throughout Rock badly broken and weathered along numerous seams

Core recovery - 75.2%

**D1327**

Compact, grey, slightly clayey to clayey, slightly sandy, slightly gravelly SILT

Top of rock

DOLOMITE, dk grey, hard, Numerous stringers of shale and considerable calcite Considerable solution and occasional weathered seams Rock broken

Core recovery - 82%

**D1331**

Loose brown uniform SAND

Soft grey slightly sandy SILT and CLAY

Soft to compact greyish-brown to grey, slightly gravelly silty SAND

Top of Rock

DOLOMITE, medium grey hard Trace of GYPSUM Rock very badly broken & slightly weathered

Core recovery - 42%

**D1326**

Fairly compact variable brown to grey, slightly clayey, slightly gravelly silty SAND

Compact grey slightly gravelly silty SAND

Top of Rock

DOLOMITE medium grey hard Occassional thin beds and stringers of shale Considerable GYPSUM throughout Rock broken but unweathered

Core recovery - 94%

**D1328**

Compact, grey, slightly clayey, slightly gravelly, slightly sandy to sandy, SILT

Top of rock

DOLOMITE, with occasional thin beds of limestone Numerous stringers of shale and calcite Considerable solution and weathering throughout Rock broken

Core recovery 85%

**D1329**

Compact, greyish-brown, slightly clayey, slightly gravelly, slightly sandy, SILT Cobbles

Compact, grey, slightly silty, slightly gravelly SAND Cobbles

Compact, grey, slightly clayey, slightly gravelly, slightly sandy, SILT Cobbles

Top of rock

DOLOMITE, hard Rock apparently slightly sheared. Considerable solution throughout Few weathered seams throughout

Core recovery 71%

**D1330**

Fairly loose, brown, slightly gravelly, silty, SAND Occasional boulders

Fairly compact to very compact, grey, slightly gravelly, silty, SAND. Occasional cobbles and boulders

Top of rock

DOLOMITE, dk grey, hard. Numerous stringers of shale and considerable calcite throughout Rock badly dissolved and weathered Rock badly broken

Core recovery 73.1%

**D1370**

Soft, brown, slightly gravelly, silty, SAND

Unable to sample.

Compact, grey, slightly gravelly, silty SAND

Top of rock

DOLOMITE, med. grey, hard Few shaly zones Considerable pyrite and calcite throughout Rock sound and unweathered

Core recovery 89%

**D1371**

Compact, brown, slightly gravelly, silty SAND

Compact, grey, slightly gravelly, silty SAND Occasional boulders

Top of rock

DOLOMITE, dk grey, hard. Occasional beds and stringers of shale. Rock moderately broken, unweathered.

Core recovery 83%

**D1375**

Fairly compact, grey, slightly sandy, slightly gravelly, clayey, SILT

Compact, grey, slightly gravelly, slightly sandy, slightly clayey, SILT

Top of rock.

DOLOMITE, med. grey, hard Numerous stringers and crystals of calcite Considerable solution and weathering Rock badly broken

Core recovery 61.5%

### DESCRIPTIVE TERMS

Slightly silty etc denotes approximately 1% to 20% by dry weight of silt etc

Silty etc. denotes approximately 20% to 40% by dry weight of silt etc

Silt and sand etc denotes approximately 40% to 60% by dry weight of silt etc except "and clay" denotes more than 30% by dry weight of clay.

NOTE:

Analyses of overburden material are based on dry samples

Analyses of bed rock are based on cores obtained by drilling

Elevations are based on Mean Sea Level, 1912 adjustment

| TRANSVERSE MERCATOR COORDINATES | | |
|---|---|---|
| HOLE NO | NORTH | EAST |
| D1254 | 1,819,894 | 394,096 |
| D1255 | 1,820,062 | 395,[illegible]82 |
| D1256 | 1,820,228 | 396,[illegible]75 |
| D1257 | 1,819,805 | 396,201 |
| D1258 | 1,820,399 | 397,053 |
| D1300 | 1,82[illegible],088 | 394,5[illegible] |
| D1301 | 1,826,066 | 39[illegible],602 |
| D1327 | 1,825,932 | 394,812 |
| D1328 | 1,825,938 | 39[illegible],422 |
| D1329 | 1,826,238 | 395,444 |
| D1330 | 1,826,260 | 395,741 |
| D1370 | 1,826,220 | 394,844 |
| D1371 | 1,826,202 | 394,243 |
| D1375 | 1,825,370 | 395,730 |
| D1326 | 1,820,390 | 399,630 |
| D1331 | 1,821,038 | 399,920 |

ST. LAWRENCE RIVER PROJECT

## CORNWALL ISL. & CORNWALL CUT

## RECORD OF FOUNDATION EXPLORATION

IN SHEETS SHEET NO SCALE

10 5 0 10 20 30

U S ENGINEER OFFICE, MASSENA, NEW YORK FEB, 1942

SUBMITTED R M Haas ENGINEER

RECOMMENDED HEAD ENGR LT. COL. CORPS OF ENGINEERS

APPROVED COL. CORPS OF ENGINEERS DISTRICT ENGINEER

DRAWN BY

CHECKED BY

CC-A-2/3

FILE NO

TRANSMITTED WITH LETTER OR ENDORSEMENT DATED

PLATE-28

ST. LAWRENCE RIVER

PROBING RESULTS

CORNWALL CUT

| Probing No. Coordinates and Surface Elevation | Depth in Feet | Blows per Foot | Feet per Hour | Samples No. | Samples Depth | Description of Samples |
|---|---|---|---|---|---|---|
| PH-4213 | | | | | | |
| N. 1,826,173 | 0-6 | Water | | | | Shore & bottom |
| E. 393,059 | 6-7 | 70 | 51 | | | very rocky |
| El. 155.4 | 7-7.6 | 417 | 9 | | | |
| | No Refusal | | | | | |
| PH-4213A | | | | | | |
| N. 1,826,163 | 0-8 | Water | | | | |
| E. 393,059 | 8-9 | 45 | 80 | | | |
| El. | 9-10 | 60 | 60 | | | |
| | No Refusal | | | | | |
| PH-4214 | | | | | | |
| N. 1,825,873 | 0-28 | Water | | | | |
| E. 393,072 | 28-28.2 | | | | | |
| El. 155.4 | Refusal | | | | | |
| PH-4215 | | | | | | |
| N. 1,825,973 | 0-19.2 | Water | | | | |
| E. 393,084 | 19.2-20 | 266 | 14 | | | |
| El. 155.3 | Refusal | | | | | |
| PH-4216 | | | | | | |
| N. 1,825,597 | 0-23 | Water | | | | |
| E. 393,689 | 23-26. | 99 | 36 | | | |
| El. 155.1 | 26-28.8 | 310 | 12 | | | |
| | Refusal | | | | | |
| PH-4217 | | | | | | |
| N. 1,825,897 | 0-16 | Water | | | | |
| E. 393,671 | Refusal | | | | | |
| El. 155.4 | | | | | | |
| PH-4218 | | | | | | |
| N. 1,826,197 | 0-10.2 | Water | | | | |
| E. 393,659 | 10.2-11.8 | 340 | 11 | | | |
| El. 155.3 | Refusal | | | | | |
| PH-4219 | | | | | | |
| N. 1,825,921 | 0-7 | Water | | | | |
| E. 394,271 | 7-16.8 | 64 | 56 | | | |
| El. 155.2 | 16.8 | 319 | 12 | | | |
| | No Refusal | | | | | |
| PH-4220 | | | | | | |
| N. 1,825,621 | 0-15.6 | Water | | | | |
| E. 394,283 | 15.6-16 | 75 | 48 | | | |
| El. 155.1 | 16-17 | 29 | 124 | | | |
| | 17-17.4 | 375 | 10 | | | |
| | Refusal | | | | | |
| PH-4220 A | | | | | | |
| N. 1,825,631 | 0-10 | Water | | | | |
| E. 394,283 | 10-17 | 40 | 90 | | | |
| El. 155.1 | 17-17.2 | 750 | 5 | | | |
| | Refusal | | | | | |
| PH-4221 | | | | | | |
| N. 1,825,646 | 0-18.5 | Water | | | | |
| E. 394,882 | 18.5-19 | 134 | 27 | | | |
| El. 155.1 | 19-19.6 | 420 | 9 | | | |
| | Refusal | | | | | |
| PH-4222 | | | | | | |
| N. 1,825,658 | 0-13 | Water | | | | |
| E. 395,182 | 13-20 | 214 | 17 | | | |
| El. 155.1 | No Refusal | | | | | |
| PH-4223 | | | | | | |
| N. 1,825,670 | 0-7 | Water | | | | |
| E. 395,482 | 7-8 | 210 | 17 | | | |
| El. 155.1 | | | | | | |
| PH-4223 | | | | | | |
| Second Attempt | 0-7 | Water | | | | |
| | 7-16 | 50 | 72 | | | |
| | 16-16.7 | 440 | 8 | | | |
| | No Refusal | | | | | |
| PH-4224 | | | | | | |
| N. 1,825,682 | 0-13 | Water | | | | |
| E. 395,781 | 13-16 | 175 | 21 | | | |
| El. 155.1 | 16-16.7 | 390 | 8 | | | |
| | Refusal | | | | | |
| PH-4225 | | | | | | |
| N. 1,825,706 | 0-15 | Water | | | | |
| E. 396,381 | 15-23. | 172 | | | | |
| El. 155.2 | 23-23.9 | 460 | 8 | | | |
| | No Refusal | | | | | |
| PH-4226 | | | | | | |
| N. 1,826,006 | 0-13 | Water | | | | |
| E. 396,369 | 13-24 | 220 | 16 | | | |
| El. 155.5 | No Refusal | | | | | |
| PH-4227 | | | | | | |
| N. 1,826,306 | 0-9.8 | Water | | | | |
| E. 396,357 | 9.8-10 | 35 | 104 | | | |
| El. 155.5 | 10-12 | 7 | 515 | | | |
| | 12-20 | 45 | 80 | | | |
| | 20-24 | 200 | 18 | | | |
| | No Refusal | | | | | |
| PH-4228 | | | | | | |
| N. 1,826,440 | 0-17 | Water | | | | |
| E. 396,874 | 17-19 | 110 | 33 | | | |
| El. 155.5 | Refusal | | | | | |
| PH-4228 A | | | | | | |
| N. 1,826,432 | 0-17 | Water | | | | |
| E. 396,874 | 17-19 | 68 | 53 | | | |
| El. 155.5 | 19-20.8 | 300 | 12 | | | |
| | Refusal | | | | | |
| PH-4229 | | | | | | |
| N. 1,826,159 | 0-20 | Water | | | | |
| E. 397,974 | 20-25 | 35 | 100 | | | |
| El. 155.5 | 25-27 | 70 | 51 | | | |
| | 27-29.1 | 300 | 12 | | | |
| | No Refusal | | | | | |
| PH-4230 | | | | | | |
| N. 1,825,876 | 0-14 | Water | | | | |
| E. 397,074 | 14-15 | 45 | [illegible] | | | |
| El. 155.5 | 15-16 | 154 | 23 | | | |
| | 16-16.8 | 600 | 6 | | | |
| | No Refusal | | | | | |
| PH-4231 | | | | | | |
| N. 1,826,124 | 0-9 | Water | | | | |
| E. 397,627 | 9-10 | 102 | 36 | | | |
| El. 155.5 | 10-10.5 | 500 | 7 | | | |
| PH 4231 A | | | | | | |
| N. 1,826,134 | 0-10 | Water | | | | |
| E. 397,627 | 10-13 | 60 | 60 | | | |
| El. 155.4 | 13-15.5 | 400 | 9 | | | |
| | No Refusal | | | | | |
| PH-4232 | | | | | | |
| N. 1,826,367 | 0-19 | Water | | | | |
| E. 397,481 | 19-21 | 225 | 16 | | | |
| El. 155.4 | 21-21.2 | 1500 | 2 | | | |
| | No Refusal | | | | | |
| PH-4233 | | | | | | |
| N. 1,826,649 | 0-18 | Water | | | | |
| E. 397,336 | 18-20 | 230 | 16 | | | |
| El. 155.4 | 20-20.6 | 500 | 7 | | | |
| | Refusal | | | | | |
| PH-4233 A | | | | | | |
| N. 1,826,659 | 0-17 | Water | | | | |
| E. 397,336 | 17-18 | 215 | 17 | | | |
| El. 155.4 | 18-22 | 50 | 72 | | | |
| | 22-24 | 150 | 24 | | | |
| | 24-24.9 | 400 | 9 | | | |
| | No Refusal | | | | | |
| PH-4234 | | | | | | |
| N. 1,826,909 | 0-19 | Water | | | | |
| E. 396,022 | 19-20 | 148 | 24 | | | |
| El. 155.4 | 20-21.3 | 700 | 5 | | | |
| | Refusal | | | | | |
| PH-4235 | | | | | | |
| N. 1,826,615 | 0-22 | Water | | | | |
| E. 398,000 | 22-24 | 240 | 15 | | | |
| El. 155.4 | 24-24.5 | 500 | 7 | | | |
| | Refusal | | | | | |
| PH-4236 | | | | | | |
| N. 1,826,320 | 0-12 | Water | | | | |
| E. 398,158 | 12-13 | 130 | 28 | | | |
| El. 155.5 | 13-15 | 67 | 54 | | | |
| | 15-18 | 130 | 28 | | | |
| | 18-18.8 | 440 | 8 | | | |
| | No Refusal | | | | | |
| PH-4237 | | | | | | |
| N. 1,826,375 | 0-5 | Water | | | | |
| E. 398,727 | 5-7 | 94 | 38 | | | |
| El. 155.5 | 7-8.3 | 240 | 15 | | | |
| | No Refusal | | | | | |
| PH-4237 A | | | | | | |
| N. 1,826,290 | 0-10 | Water | | | | |
| E. 398,727 | 10-15 | 110 | 32 | | | |
| El. 155.5 | 15-17 | 210 | 17 | | | |
| | 17-17.4 | 500 | 7 | | | |
| | No Refusal | | | | | |
| PH-4238 | | | | | | |
| N. 1,826,678 | 0-21 | Water | | | | |
| E. 398,742 | 21-22.3 | 300 | 12 | | | |
| El. 155.5 | Refusal | | | | | |
| PH-4239 | | | | | | |
| N. 1,826,980 | 0-22.5 | Water | | | | |
| E. 398,758 | 22.5-23 | 206 | 17 | | | |
| El. 155.5 | 23-29 | 50 | 72 | | | |
| | 29-32 | 130 | 28 | | | |
| | 32-32.5 | 520 | 7 | | | |
| | No Refusal | | | | | |

FILE NO CC-A-2/4

PLATE-29

## ST. LAWRENCE RIVER

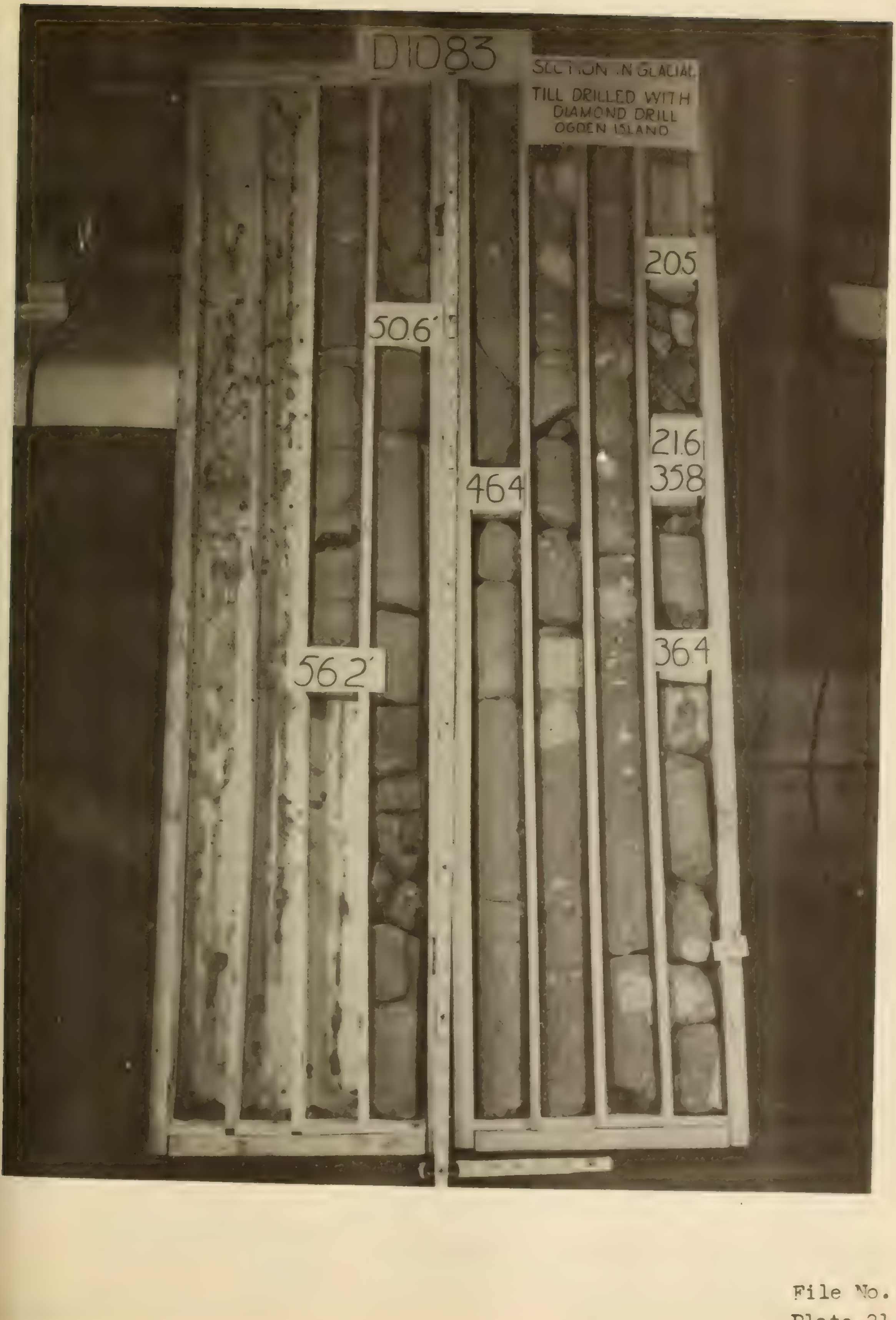
## PROBING RESULTS

## CORNWALL CUT

| Probing No. Coordinates and Surface Elevation | Depth in Feet | Blows per Foot | Feet per Hour | Samples No. | Samples Depth | Description of Samples | Probing No. Coordinates and Surface Elevation |
|---|---|---|---|---|---|---|---|
| PH-4240 | | | | | | | |
| N. 1,826,859 | 0-21 | Water | | | | | |
| E. 399,448 | 21-22 | 126 | 28 | | | | |
| EL. 155.5 | 22-28 | 70 | 52 | | | | |
| | 28-28.8 | 500 | 7 | | | | |
| | No Refusal | | | | | | |
| PH-4241 | | | | | | | |
| N. 1,826,574 | 0-26 | Water | | | | | |
| E. 399,356 | 26-27 | 218 | 16 | | | | |
| EL. 155.5 | 27-31 | 70 | 52 | | | | |
| | 21-21.8 | 460 | 8 | | | | |
| | No Refusal | | | | | | |
| PH-4242 | | | | | | | |
| N. 1,826,288 | 0-8 | Water | | | | | |
| E. 399,263 | 8-11 | 50 | 72 | | | | |
| EL 155.5 | 11-12 | 140 | 26 | | | | |
| | 12-12.6 | 600 | 6 | | | | |
| | No Refusal | | | | | | |
| PH-4243 | | | | | | | |
| N. 1,830,069 | 0-17 | Water | | | | | |
| E. 399,733 | 17-20 | 35 | 103 | | | | |
| EL. 155.4 | 20-20.5 | 644 | 6 | | | | |
| | No Refusal | | | | | | |
| PH-4244 | | | | | | | |
| N. 1,826,324 | 0-28 | Water | | | | | |
| E 399,892 | 28-31 | 200 | 18 | | | | |
| EL. 155.4 | 31-32 | 510 | 7 | | | | |
| | No Refusal | | | | | | |
| PH-4245 | | | | | | | |
| N. 1,826,578 | 0-23 | Water | | | | | |
| E. 400,151 | 23-25 | 300 | 12 | | | | |
| EL. 155.4 | 25-26.2 | 600 | 6 | | | | |
| | No Refusal | | | | | | |

FILE NO CC-A-2/5

PLATE-30

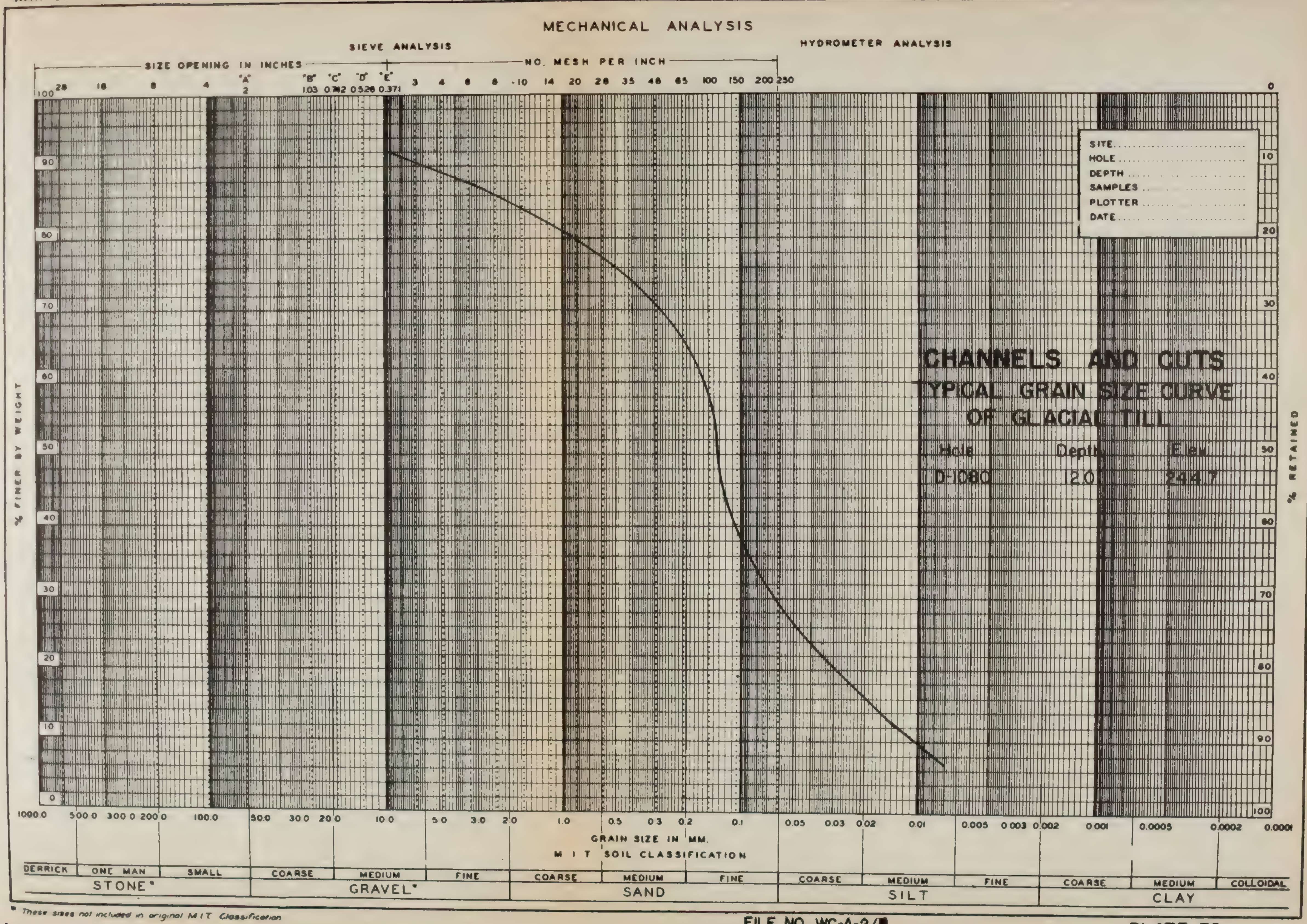

D1083
SECTION IN GLACIAL TILL DRILLED WITH DIAMOND DRILL OGDEN ISLAND
20.5
50.6'
21.6
35.8
46.4
36.4
56.2'

U. S. Engineer Office
St. Lawrence River District
Massena, N. Y.

Glacial Till
Hole D-1083

April 22, 1941

File No. SL39
Plate 31



**CHANNELS AND CUTS**
**TYPICAL GRAIN SIZE CURVE OF GLACIAL TILL**

| Hole | Depth | Elev. |
|---|---|---|
| D-1080 | 12.0 | 244.7 |

FILE NO. WC-A-2/[redacted]

PLATE 32

# SUBSURFACE INVESTIGATIONS AND EARTHWORK DESIGN
# FOR CORNWALL CANAL RELOCATION

(Pertains to Features 25, 26, 27 and 28)

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1. Plan of Exploration and Rock Contour Map
2. Dike Locations
3. Record of Exploration
4. Record of Exploration
5,6,7, 8,9, Probing Results
10, Typical Grain Size Curves

# SUBSURFACE INVESTIGATIONS AND EARTHWORK DESIGN FOR THE CORNWALL CANAL RELOCATION
## ST. LAWRENCE RIVER PROJECT
## FEBRUARY 1942

## I. INTRODUCTION

1. Purpose and Scope. - This report describes the exploration, the field and laboratory tests and geological studies completed February 1942 at Cornwall Canal Relocation and dike sites as conducted by the St. Lawrence River District, U. S. Engineer Office, Massena, New. York. It also presents the results and conclusions of all these investigations so that these data may be available for the design of the proposed structures. The design of the embankments, canal slopes and lock foundation will necessarily involve a thorough study of the foundation conditions and characteristics, a study of the characteristics of the available embankment materials and the choice of sections which will utilize the available embankment materials and will be safe under any probable conditions. While the investigations to date are far from complete, the embankment designs and treatment of the lock foundation discussed in this section have been based on the information at hand supplemented by the necessary assumptions. Final designs cannot be made until more investigations are completed. The discussion of the proposed canal and lock location is presented in the final report under features Nos. 27 and 28.

2. Description of Site. - The canal relocation, New Cornwall Canal Dike, Mille Roche Dike, the Moulinette Dikes Nos. 1 and 2, and the Bergen Lake Dike No. 1 are located along the Canadian shore between Bergen Lake and Lock 19. The canal is located along the side of a till ridge which is nearly buried beneath an alluvial sand and clay blanket. The depth of sand and clay varies from 0 to 40 feet along the canal alignment. The New Cornwall Canal Dike leaves the lock and skirts the deep clay deposit in Robertson's Creek and then extends across a series of till hills and clay valleys until it terminates on high ground ½ miles north of Mille Roche. Mille Roche Dike No. 1, Moulinette Dikes Nos. 1 and 2 and Bergen Lake Dike No. 1 are all very low dikes which extend between high points. The foundations beneath these latter dikes are generally firm.

## II. FIELD EXPLORATION OF FOUNDATIONS

3. General. - Prior to October 1940, the Governments of Canada and the United States made investigations in the vicinity of the Cornwall Canal Relocation for the purpose of determining the overburden and bedrock conditions. The field exploration was of a very preliminary nature and the logs of only 3 of the holes are on file in the district office. The location of all drilling prior to October 1940 is shown on Plate 1. Overburden and bedrock exploration at the lock, guard gate, canal, New Cornwall Canal and other dike sites since October 1940, conducted by the U. S. Corps of Engineers for the purpose of obtaining information for designs included geological reconnaissance, drilling in overburden and rock, probing in soft overburden and the determination of bedrock elevations and study of general soil conditions by the seismic method. Exploration in the

vicinity of Mille Roche, Moulinette Nos. 1 and 2, and Bergen Lake No. 1 dike has been limited to geological reconnaissance. Most of the drilling has bee done on the 1926 alignment of the canal and only three holes have been drill with specific reference to the present alignment shown on Plate 1. The majority of the probings were made to locate the most economical dike location across Robertson Creek. The location and extent of the exploration at the sites are shown on Plates 1 and 2. Complete reports of the drill holes, field logs of the probings, and notes and computations of the seismic investigations are on file in the district office. Records of the drilling exploration are shown on Plates 3 and 4 and the tabulation of the probing data is shown on Plate 5 to 9 inclusive. All soil samples and bedrock cores are stored in the district soils laboratory.

4. Drill Holes. - Holes of three sizes were drilled in the vicinity of the canal and dike sites. Holes for the purpose of determining both overburden and bedrock conditions were drilled with diamond core drilling equipment using 3½-inch casing in the overburden and 2-1/8-inch bit to obtain bedrock cores. Holes drilled specifically for overburden investigation have been drilled using 2½-inch or 6-inch casing. When 3½ or 2½-inch casings were used the overburden was dry sampled using a sampling tube 2 inches and 1½ inches in diameter respectively. Soil samples were usually taken at 5-foot intervals or at changes in material and wash boring between samples was permitted. Undisturbed soil samples were obtained with a spoon specially constructed by Sprague & Henwood, Inc. from drill holes D-1398 which was drilled using a 6-inch casing. The spoon obtains samples 4-5/8 inches in diameter and has recessed flaps above the cutting shoe which are closed with a wire snare to retain the sample in the spoon. The spoon is also equipped with steel liners, 0.12 inches thick and 12-inches long. To date 18 holes have been drilled using 3½-inch casing with a total footage of 1,029.4 feet in overburden and 367.8 feet in rock. Four holes have been completed using 2½-inch casing with a total footage of 111.6 feet in overburden. One hole using 6-inch casing has been completed with a total footage of 47.1 feet in overburden. 22 undisturbed samples were obtained.

5. Probings. - Holes were probed to generally determine the depth and consistency of the clay in the various arreas. The holes were probed with a Highmark Probing machine using 1¼-inch diameter probing pipe with a removable closed pointed end. Samples were taken with a sampler 3/8 inches in diameter after the closed, pointed end was retracted without pulling the casing. The probing pipe was driven with a hammer weighing 163 pounds, dropping approximately 15 inches at an average rate of 50 blows per minute. To date 154 holes have been probed with a total footage of 3662.3 feet.

6. Seismic Investigations. - Preliminary investigations for determining the location of bedrock and existing soil conditions in the vicinity of the canal were conducted using the seismic method. The method used was developed by E. R. Shepard, Senior Physicist, Office of the Chief of Engineers (for a brief description, see article "The Seismic Method of Exploration Applied to Construction Projects" by E. R. Shepard, the Military Engineer, September - October 1939.) A Total of 7 seismic lines were fired in the vicinity of the canal. A detailed report of the seismic investigations conducted for the St. Lawrence River Project is on file in the district office.

## III. EXPLORATION OF EMBANKMENT MATERIALS AND CONCRETE AGGREGATES

7. Earth and Rock Fill. - The exploration described in paragraph 1-02 for the overburden and bedrock served to determine the suitability of the canal and lock excavation for earth and rock fill materials for backfill and dikes. No exploration was made for the location of earth fill borrow areas but from the general geology of the area it is known that suitable materials in close proximity to the sites. Some rock is available from the lock excavation, however, this quantity will not be sufficient to meet requirements and rock will have to be borrowed to complete construction. Considerable rock may be available from rock excavation at the powerhouse site. During exploration for concrete aggregates for the St. Lawrence River Project all rock outcrops and probably quarry sites which were economically located were investigated and the report of these investigations are on file in the district office.

8. Sand and Gravel Filter. - Exploration was conducted to locate deposits of suitable material or the sand and gravel filters and backing of the dikes. It is believed that all deposits within a radius of 15 miles of the site have been located. The most feasible deposits were sampled and tested to determine the gradation of the materials. A complete report of these investigations will be placed on file in the district office.

9. Concrete Aggregates. - Exploration to locate suitable sources of concrete aggregates are being conducted. It is planned that the explorations will be completed so that information will be available prior to letting of the contract. Many deposits of sand and gravel within a radius of 15 miles of the site have been sampled and representative samples have been tested in the Central Concrete Laboratory, West Point, New York, to determine the suitability of the materials for concrete aggregates. All rock quarries in the vicinity have been sampled and the materials tested in the Central Concrete Laboratory. Studies are being made to determine if suitable stone sand can be produced from local rock for fine concrete aggregate. Natural deposits of sand and gravel are being explored which are outside of a 25-mile radius and are near a railroad or near the St. Lawrence River. Complete report of all investigations will be placed on file in the district office.

## IV. LABORATORY TESTS ON SOILS

10. General. - An extensive program of soil testing has not been made to date. However, a preliminary program of shear and consolidation tests on undisturbed clay samples is now being conducted at the Syracuse District Soils Laboratory at Ithaca, N. Y. This program will have to be completed before a preliminary design can be made for the dike sections over the clay areas and the canal slopes in the clay area. With the exception of the marine clays encountered, the type of overburden materials in the excavation and foundation areas and the materials available for embankment construction are such that an extensive testing program was not necessary. Soil samples taken during drilling were classified using the M.I.T. scale of classification and recorded in a report of each hole. The grain size distribution of a number of samples were determined by the usual seive and

hydrometer methods to serve as a guide in the classification of all samples. General geological descriptions of the overburden at each drill hole were prepared after studying the laboratory classifications and the field log. The small soil samples obtained with the probing equipment were classified by a trained expert. Only a general classification of each sample was recorded. Moisture contents of 98 samples from drill holes were determined and one specific gravity test was made. No natural density determinations or permeability tests have been made. Testing is now in progress on undisturbed samples taken from D-1398 to determine the shear and consolidation characteristics, natural density, specific gravity, variation of water contents, and Atterburg limits of the clay in the vicinity of Robertson's Creek. These results will be on file in the district office.

## V. LABORATORY TESTS ON ROCK

11. General. - The rock cores obtained from drill holes were classified by a geologist. The condition of the bedrock was determined by an interpretation of the field logs and visual examination of the cores. Detailed and general classifications are recorded in the final report of each hole.

## VI. CHARACTERISTICS OF FOUNDATION MATERIAL AS DETERMINED BY FIELD AND LABORATORY INVESTIGATIONS

12. Overburden. - The overburden throughout the entire region consists of glacial till which is overlain in some areas by deposits of marine clay, silt and sand. In the vicinity of Robertson's Creek and the lock site the depths to firm material, which is generally glacial till, as determined by probings vary up to 50 feet. The soft material consists of gray marine clay which is generally overlain by 5 to 10 feet of uniform sand.

13. The foundation overburden in the area northwest of Robertson's Creek area is generally glacial till with the exception of the two areas in which drilling and probing were conducted (see Plate 2). In the valley at the present railroad location, clay is generally less than 20 feet in depth and extends along the dike centerline for a distance of approximately 300 feet. In the valley near the west end of the New Cornwall Canal Dike marine deposits varying in a depth from 10 to 20 feet are found. The upper 3 to 8 feet of these deposits consist generally of sand and silt which is underlain by clay. The foundations of the other small dikes shown on Plate 2 appear to consist entirely of glacial till.

14. The glacial tills existing in the vicinity of the Cornwall Canal Relocation and the dike sites are variable but consist mainly of silty, gravelly sands and sandy gravelly silts. In general the top 10 feet of till is loose to fairly compact below which the material is compact. It is estimated that the natural density of the material is approximately 140 lbs. per cu. ft., that the coefficient of permeability varies between 0.00001 and 0.0000001 cm. per sec., and that in nature the angle of internal friction is greater than 30 degrees. The grey clay especially in the Robertson's Creek area is very soft and it is believed that its shearing strength is ver low. The average water content of the grey clay based on dry weight averag 65 percent. The shearing strength of the material is being determined at this time. Typical grain size curves of the materials encountered are show on Plate 10.

15. Bedrock. - The bedrock in the region of the New Cornwall Canal and dikes as shown by cores recovered from drilling consists of a series of sedimentary rocks believed to be the Chazy and Black River formations which are Ordovician in age. The rock consists chiefly of limestone interbedded with shale and thin beds of dolomite and sandstone. The rock is almost horizontally bedded conforming the general, very gentle northerly dip of the strata in the region. The rock is generally sound and unweathered. Small broken zones occur along bedding planes and some of the joints which cut the bedding at various angles. Bedrock contours drawn from drill hole and seismic information in the vicinity of the lock and canal site are shown on Plate 1. The rock contours have been extended beyond the areas of exploration to show the general trend of the rock surface and, therefore, the validity of the rock contours must be gaged by the intensity of the exploration in any area.

## VII. EARTHWORK DESIGN AND TREATMENT OF LOCK FOUNDATION

16. New Cornwall Canal Dike - The location of the New Cornwall Canal dike has been a major problem. The present location is shown on Plate 2. The maximum height of the dike at the Robertson's Creek crossing is approximately 55 feet. Comparison studies have been made for different types of structures such as earth dikes, cribs and concrete walls crossing the creek at various locations. These studies have shown that an earth section following the alignment shown on Plate 2 is the most economical. In order to keep as much of the dike as possible on firm material, the location of the lock has been limited in an easterly direction to the present site. For the purpose of cost and quantity estimates the dike sections on firm material have been assumed to be similar to those shown for the Barnhart Island Powerhouse, South Forebay dike (see contract drawings of Barnhart Island Powerhouse) and those sections to be built on clay areas have been tentatively assigned the slopes of 1 on 10 except at the Robertson Creek crossing where slopes of 1 on 20 were assigned. At the present time it is proposed to design the dike to float on all clay area except across the valley at the intersection of the dike alignment with the present railroad location. Because of the small quantity of clay it is considered advisable to excavate to firm material in this area.

17. Suitable earth materials are economically located along the dike in the near vicinity. Sand and gravel filter and backing materials can be obtained from deposits within 15 miles of the site. The majority of the riprap will have to be borrowed and as there is considerable rock excavation at the powerhouse site it amy be economical to use that rock. No mathematical analyses have been made for the embankment sections. Based on the experience with similar materials and foundation conditions, analyses of dike sections founded on firm material are believed unnecessary. Mathematical analyses will have to be made prior to the design of the sections of the dike which will be constructed on the clay areas.

18. Mille Roche No. 1, Moulinette Nos. 1 and 2, and Bergen Lake No. 1 Dikes. - The locations of these dikes are shown on Plate 2. All dikes are believed to have firm foundation conditions and as the dikes are not over 10 feet high no mathematical analyses are necessary. Suitable earth borrow materials are available in the near vicinity of each of the dikes. Sand

and gravel for backing and rocks for riprap can be obtained within 15 miles of the sites. For cost and quantity estimates the sections have been assumed to be similar to the Barnhart Island Powerhouse South Forebay Dike.

19. Canal Slopes. - A preliminary study has been made of the soil conditions along the canal excavation with particular attention being given to the depth of clay. No mathematical analyses have been made, however, it is believed that throughout the canal with the exception of 1,000 feet at the upper end, a slope of 1 on 2 will be amply safe against any major slide. In some sections very minor slides may occur due to unusual soil conditions. However, these conditions exist, it is believed that the slope that can be constructed will be stable after construction. The canal slopes in the 1,000 foot section at the upper end will have to be analyzed after the shearing strength of the clay has been determined as the depth of clay varies between 20 and 50 feet.

20. Treatment of Lock Foundation. - The foundation of the lock will be sound rock. All loose weathered or badly fractured rock will be excavated to produce a suitable foundation. The bedrock will be thoroughly grouted. Any shale beds will be excavated to found the base of the structure on beds of other rocks.

21. Economy of Construction. - The present alignment of the embankments and location of the structures appear to be the most economical. The embankments will be composed of suitable earth and rock fill materials from the lock and canal excavations and from borrow areas. Provisions will be made to utilize all stone and boulders from the earth fill materials. The quantity of sand and gravel and riprap will be kept to a minimum believed feasible in the designs necessary to fulfill all design criteria.

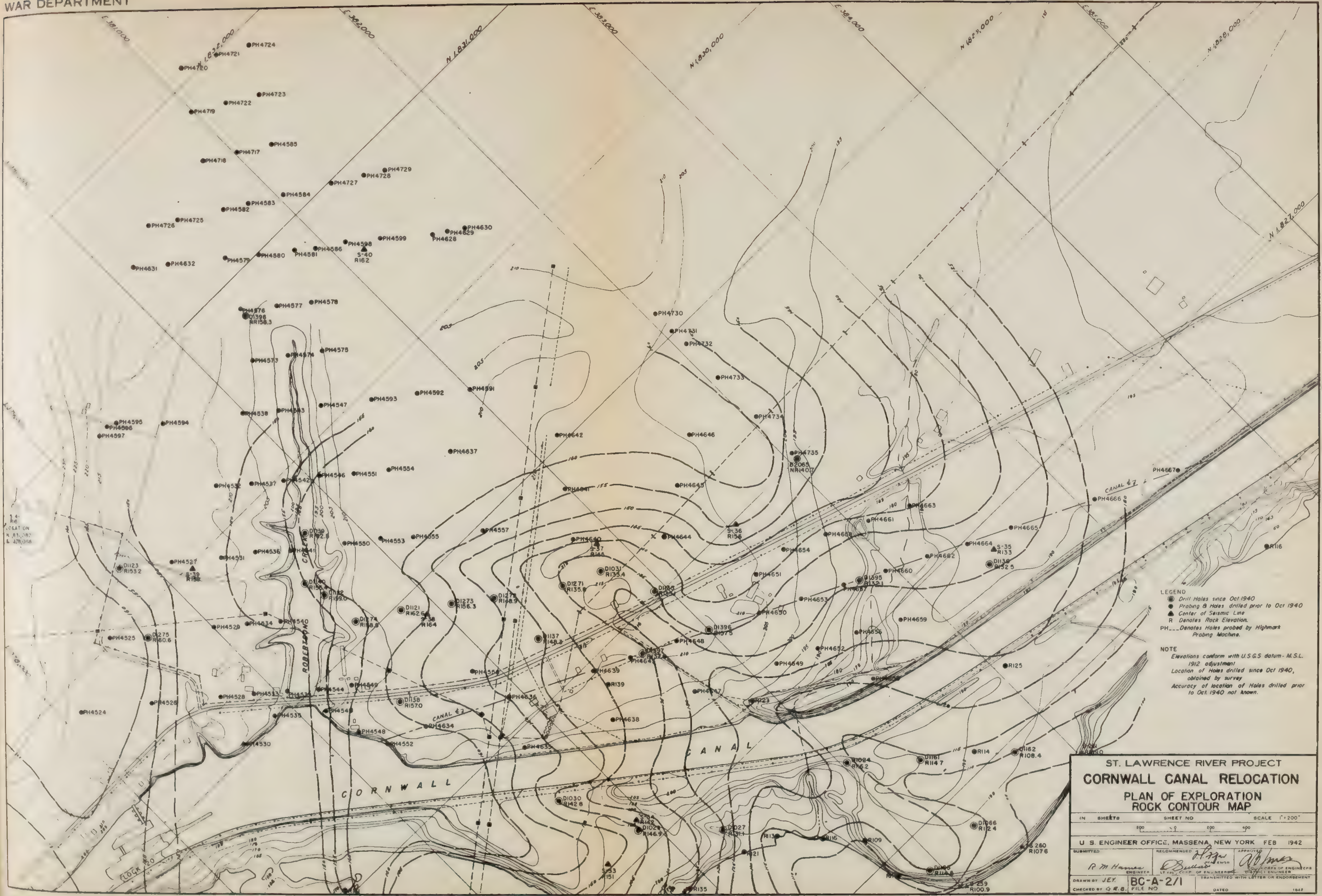
## VIII. RECOMMENDED FUTURE INVESTIGATIONS AND DESIGNS.

22. Field Exploration. - Prior to designing the dikes the extent and depth of the soft grey clay in the foundation areas should be determined. It is recommended that sufficient exploration be conducted to trace the clay along the dike locations and also that one or more additional 6-inch holes be drilled to obtain undisturbed samples of the clay for laboratory tests. Also sufficient drilling should be conducted at the lock site to definitely determine the elevation and character of the bedrock and it is believed advisable to drill one hole to a sufficient depth in rock to assure that no large cavities or gypsum beds exist at an elevation where they could cause difficulty. This hole should be pressure tested. Any probable borrow area sites should be explored with test pits and drill holes to assure the selection of the most suitable materials.

23. Laboratory Investigations. - The undisturbed samples of clay obtained from the proposed 6-inch drilling should be tested to determine the shearing strength and consolidation characteristics of the material as this information must be obtained before the design of the dikes over the clay areas. All necessary routine tests will be made on all foundation and borrow materials explored in the future. Tests should be made during construction to determine the relation between construction to determine the relation between water content and unit weight to be obtained when compacting the materials in the embankment. No laboratory tests on the

bedrock are recommended.

24. Designs. - To date no designs have been made. After the recommended future exploration has been completed and the stress strain characteristics of the soft grey clay determined, it will be possible to adequately design all the dike sections.



LEGEND
- ◉ Drill Holes since Oct 1940
- ● Probing & Holes drilled prior to Oct 1940
- ▲ Center of Seismic Line
- R Denotes Rock Elevation
- PH___Denotes Holes probed by Highmark Probing Machine.

NOTE

Elevations conform with U.S.G.S datum - M.S.L. 1912 adjustment

Location of Holes drilled since Oct 1940, obtained by survey

Accuracy of location of Holes drilled prior to Oct. 1940 not known.

ST. LAWRENCE RIVER PROJECT

# CORNWALL CANAL RELOCATION

## PLAN OF EXPLORATION
## ROCK CONTOUR MAP

IN SHEETS SHEET NO SCALE 1"=200'

200 0 200 400

U. S. ENGINEER OFFICE, MASSENA, NEW YORK FEB 1942

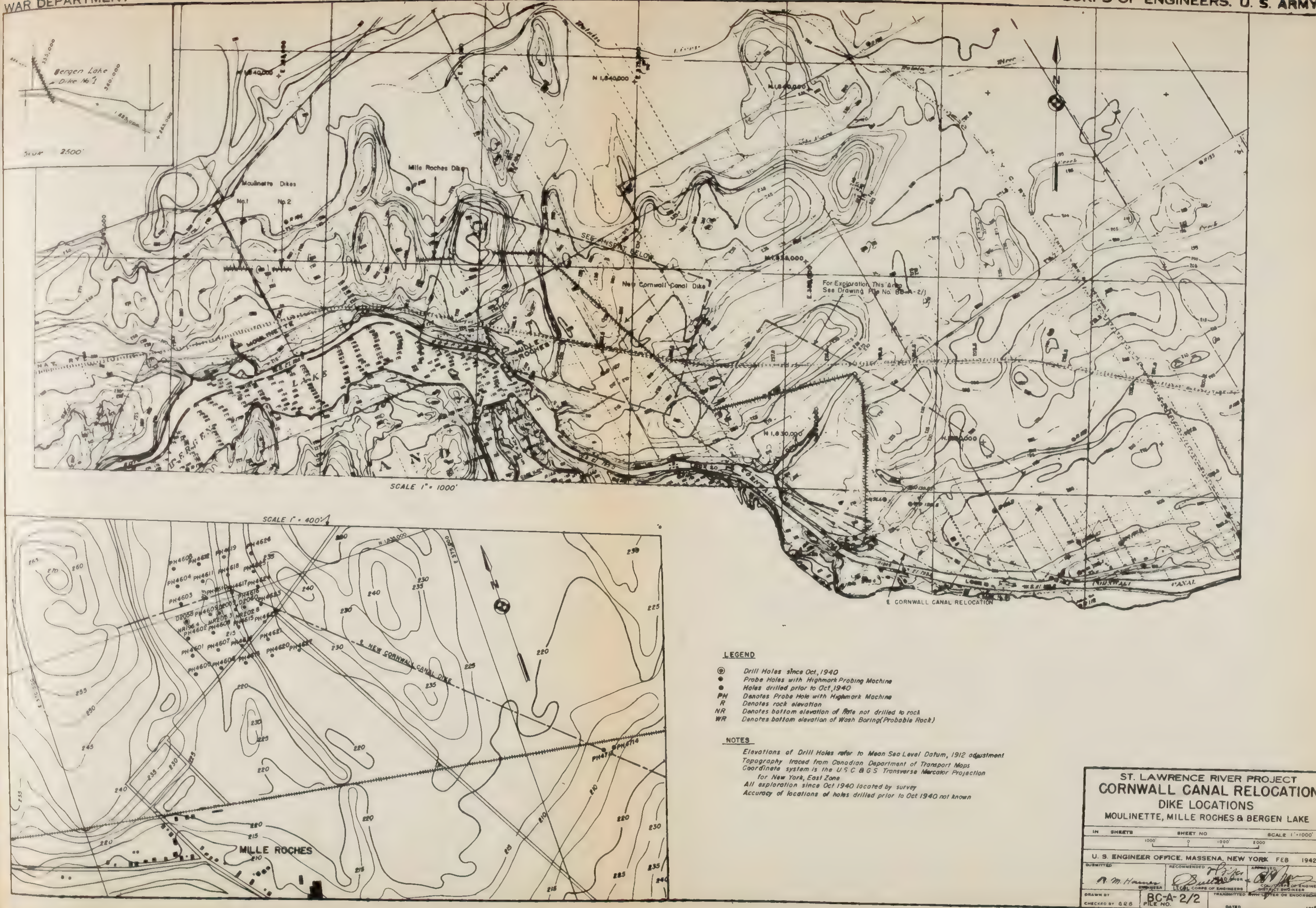
| SUBMITTED | RECOMMENDED | APPROVED |
|---|---|---|
| R M Hamee<br>ENGINEER | D Bullard<br>LT COL, CORP OF ENGINEERS | A B Jones<br>CORPS OF ENGINEERS<br>DISTRICT ENGINEER |

DRAWN BY J.E.Y.
CHECKED BY G.R.B.

BC-A-2/1
FILE NO

TRANSMITTED WITH LETTER OR ENDORSEMENT
DATED 194

PLATE 1



**LEGEND**

| | |
|---|---|
| ◉ | Drill Holes since Oct., 1940 |
| ● | Probe Holes with Highmark Probing Machine |
| ● | Holes drilled prior to Oct., 1940 |
| PH | Denotes Probe Hole with Highmark Machine |
| R | Denotes rock elevation |
| NR | Denotes bottom elevation of hole not drilled to rock |
| WR | Denotes bottom elevation of Wash Boring (Probable Rock) |

**NOTES**

Elevations of Drill Holes refer to Mean Sea Level Datum, 1912 adjustment
Topography traced from Canadian Department of Transport Maps
Coordinate system is the U.S.C.&G.S. Transverse Mercator Projection
for New York, East Zone
All exploration since Oct 1940 located by survey
Accuracy of locations of holes drilled prior to Oct 1940 not known

ST. LAWRENCE RIVER PROJECT
CORNWALL CANAL RELOCATION
DIKE LOCATIONS
MOULINETTE, MILLE ROCHES & BERGEN LAKE

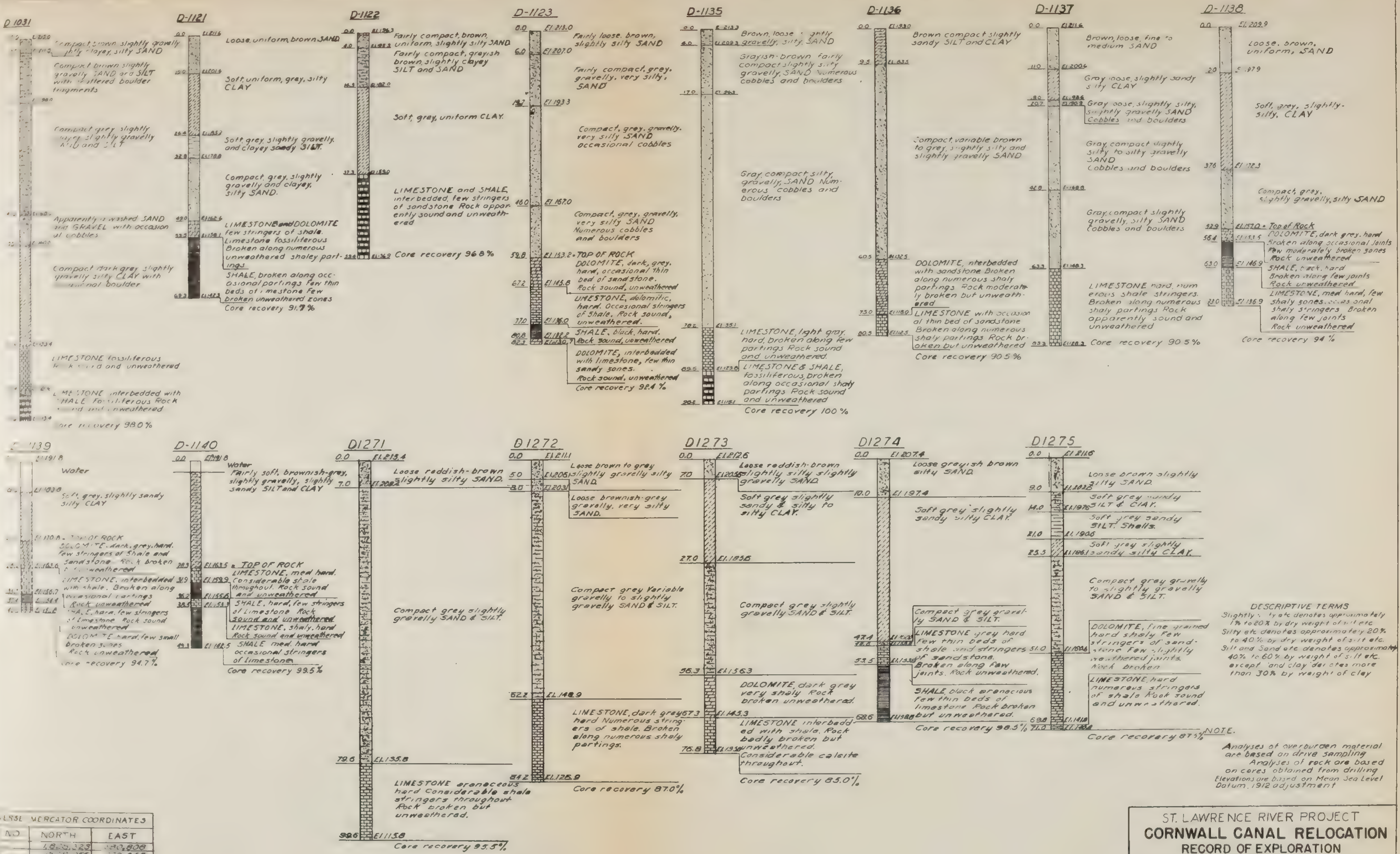
IN SHEETS SHEET NO SCALE 1"=1000'
1000' 0 1000' 2000

U. S. ENGINEER OFFICE, MASSENA, NEW YORK FEB 1942

SUBMITTED R. M. Hamer ENGINEER
RECOMMENDED HEAD ENGR LT. COL. CORPS OF ENGINEERS
APPROVED COL. CORPS OF ENGINEERS DISTRICT ENGINEER
DRAWN BY
CHECKED BY G.R.B.
BC-A-2/2
FILE NO.
TRANSMITTED WITH LETTER OR ENDORSEMENT
DATED 1942

WAR DEPARTMENT

CORPS OF ENGINEERS, US ARMY


D 1031
Compact brown slightly gravelly silty clayey, silty SAND
Compact brown slightly gravelly SAND and SILT with scattered boulder fragments
Compact grey slightly clayey slightly gravelly SAND and SILT
Apparently a washed SAND and GRAVEL with occasional cobbles
Compact dark grey slightly gravelly silty CLAY with occasional boulder
LIMESTONE fossiliferous Rock sound and unweathered
LIMESTONE interbedded with SHALE Fossiliferous Rock sound and unweathered
Core recovery 98.0%
D-1121
0.0 El. 211.6 Loose, uniform, brown SAND
10.0 El. 201.6 Soft, uniform, grey, silty CLAY
26.4 El. 185.2 Soft, grey, slightly gravelly, and clayey sandy SILT
32.8 El. 178.8 Compact, grey, slightly gravelly and clayey, silty SAND.
49.0 El. 162.6 LIMESTONE and DOLOMITE few stringers of shale. Limestone fossiliferous Broken along numerous unweathered shaley partings
53.5 El. 158.1 SHALE, broken along occasional partings Few thin beds of limestone Few broken unweathered zones
69.3 El. 142.3 Core recovery 91.7%
D-1122
0.0 El. 196.3 Fairly compact, brown, uniform, slightly silty SAND
4.0 El. 192.3 Fairly compact, greyish brown, slightly clayey SILT and SAND
14.3 El. 182.0 Soft, grey, uniform CLAY.
37.3 El. 159.0 LIMESTONE and SHALE, interbedded, few stringers of sandstone Rock apparently sound and unweathered
53.4 El. 142.9 Core recovery 96.8%
D-1123
0.0 El. 213.0 Fairly loose, brown, slightly silty SAND
6.0 El. 207.0 Fairly compact, grey, gravelly, very silty, SAND
19.7 El. 193.3 Compact, grey, gravelly, very silty SAND occasional cobbles
46.0 El. 167.0 Compact, grey, gravelly, very silty SAND Numerous cobbles and boulders
59.8 El. 153.2 • TOP OF ROCK DOLOMITE, dark, grey, hard, occasional thin bed of sandstone. Rock sound, unweathered
67.2 El. 145.8 LIMESTONE, dolomitic, hard. Occasional stringers of Shale. Rock sound, unweathered.
77.0 El. 136.0 SHALE, black, hard. Rock sound, unweathered
80.8 El. 132.2
82.3 El. 130.7 DOLOMITE, interbedded with limestone, few thin sandy zones. Rock sound, unweathered
Core recovery 92.4%
D-1135
0.0 El. 213.3 Brown, loose slightly gravelly, silty SAND
4.0 El. 209.3 Grayish-brown fairly compact slightly silty gravelly, SAND Numerous cobbles and boulders
17.0 El. 196.3 Gray, compact silty, gravelly, SAND Numerous cobbles and boulders
78.2 El. 135.1 LIMESTONE, light gray, hard, broken along few partings Rock sound and unweathered.
89.5 El. 123.8 LIMESTONE & SHALE, fossiliferous, broken along occasional shaly partings Rock sound and unweathered
98.2 El. 115.1 Core recovery 100%
D-1136
0.0 El. 193.0 Brown compact slightly sandy SILT and CLAY
9.5 El. 183.5 Compact, variable brown to grey, slightly silty and slightly gravelly SAND
60.5 El. 132.5 DOLOMITE, interbedded with sandstone Broken along numerous shaly partings Rock moderately broken but unweathered
75.0 El. 118.0 LIMESTONE with occasional thin bed of sandstone Broken along numerous shaly partings Rock broken but unweathered
80.5 El. 112.5 Core recovery 90.5%
D-1137
0.0 El. 211.6 Brown, loose, fine to medium SAND
11.0 El. 200.6 Gray loose, slightly sandy silty CLAY
19.0 El. 192.6
20.7 El. 190.9 Gray loose, slightly silty, slightly gravelly SAND Cobbles and boulders
Gray, compact slightly silty to silty gravelly SAND Cobbles and boulders
43.0 El. 168.6 Gray, compact slightly gravelly, silty SAND Cobbles and boulders
63.3 El. 148.3 LIMESTONE hard, numerous shale stringers. Broken along numerous shaly partings Rock apparently sound and unweathered
83.3 El. 128.3 Core recovery 90.5%
D-1138
0.0 El. 209.9 Loose, brown, uniform, SAND
2.0 El. 197.9 Soft, grey, slightly-silty, CLAY
37.6 El. 172.3 Compact, grey, slightly gravelly, silty SAND
42.9 El. 157.0 • Top of Rock DOLOMITE, dark grey, hard Broken along occasional Joints Few moderately broken zones Rock unweathered
56.4 El. 153.5 SHALE, black, hard Broken along few joints Rock unweathered
63.0 El. 146.9 LIMESTONE, med hard, few shaly zones, occasional shaly stringers Broken along few joints Rock unweathered
73.0 El. 136.9 Core recovery 94%
D-1139
El. 191.8 Water
El. 183.8 Soft, grey, slightly sandy silty CLAY
El. 170.8 • TOP OF ROCK DOLOMITE, dark, grey, hard. Few stringers of Shale and Sandstone Rock broken but unweathered
El. 163.6 LIMESTONE, interbedded with shale. Broken along occasional partings Rock unweathered
El. 156.7 SHALE, hard, few stringers of Limestone Rock sound unweathered
El. 154.4 DOLOMITE hard, few small broken zones Rock unweathered
Core recovery 94.7%
D-1140
0.0 El. 191.8 Water
Fairly soft, brownish-grey, slightly gravelly, slightly sandy SILT and CLAY
28.3 El. 163.5 • TOP OF ROCK LIMESTONE, med hard. Considerable shale throughout. Rock sound and unweathered
31.9 El. 159.9
36.2 El. 155.6 SHALE, hard, few stringers of Limestone Rock sound and unweathered
38.5 El. 153.3 LIMESTONE, shaly, hard Rock sound and unweathered
49.3 El. 142.5 SHALE med. hard occasional stringers of limestone
Core recovery 99.5%
D1271
0.0 El. 213.4 Loose reddish-brown slightly silty SAND.
7.0 El. 206.4 Compact grey slightly gravelly SAND & SILT.
79.6 El. 135.8 LIMESTONE arenaceous hard Considerable shale stringers throughout Rock broken but unweathered.
99.6 El. 115.8 Core recovery 95.5%
D1272
0.0 El. 211.1 Loose brown to grey slightly gravelly silty SAND.
5.0 El. 206.1
8.0 El. 203.1 Loose brownish-grey gravelly, very silty SAND.
Compact grey Variable gravelly to slightly gravelly SAND & SILT.
62.2 El. 148.9 LIMESTONE, dark grey hard Numerous stringers of shale. Broken along numerous shaly partings.
84.2 El. 126.9 Core recovery 87.0%
D1273
0.0 El. 212.6 Loose reddish-brown slightly silty slightly gravelly SAND.
7.0 El. 205.6 Soft grey slightly sandy & silty to silty CLAY.
27.0 El. 185.6 Compact grey slightly gravelly SAND & SILT.
56.3 El. 156.3 DOLOMITE, dark grey very shaly Rock broken unweathered.
67.3 El. 145.3 LIMESTONE interbedded with shale. Rock badly broken but unweathered. Considerable calcite throughout.
76.8 El. 135.8 Core recovery 85.0%
D1274
0.0 El. 207.4 Loose greyish brown silty SAND.
10.0 El. 197.4 Soft grey slightly sandy silty CLAY.
Compact grey gravelly SAND & SILT.
47.4 El. 160.0
53.5 El. 153.9 LIMESTONE grey hard Few thin beds of shale and stringers of sandstone. Broken along few joints. Rock unweathered.
SHALE, black arenaceous Few thin beds of limestone Rock broken but unweathered.
68.6 El. 138.8 Core recovery 98.5%
D1275
0.0 El. 211.6 Loose brown slightly silty SAND.
9.0 El. 202.6 Soft grey sandy SILT & CLAY.
14.0 El. 197.6 Soft grey sandy SILT. Shells.
21.0 El. 190.6 Soft grey slightly sandy silty CLAY.
25.5 El. 186.1 Compact grey gravelly to slightly gravelly SAND & SILT.
51.0 El. 160.6 DOLOMITE, fine grained hard shaly Few stringers of sandstone Few slightly weathered joints. Rock broken
LIMESTONE, hard numerous stringers of shale Rock sound and unweathered.
69.8 El. 141.8
71.0 El. 140.6 Core recovery 87.5%

DESCRIPTIVE TERMS

Slightly silty etc denotes approximately 1% to 20% by dry weight of silt etc

Silty etc denotes approximately 20% to 40% by dry weight of silt etc.

Silt and Sand etc denotes approximately 40% to 60% by weight of silt etc. except sand clay denotes more than 30% by weight of clay

NOTE.

Analyses of overburden material are based on drive sampling

Analyses of rock are based on cores obtained from drilling

Elevations are based on Mean Sea Level Datum, 1912 adjustment

| TRANSVERSE MERCATOR COORDINATES | | |
|---|---|---|
| HOLE NO. | NORTH | EAST |
| [illegible] | [illegible] | 380,808 |
| [illegible] | [illegible] | 379,458 |
| [illegible] | [illegible] | 379,592 |
| [illegible] | [illegible] | [illegible] |
| [illegible] | 4828,[illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | 379,483 |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | 379,557 |
| [illegible] | 4829,420 | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | 378,690 |

ST. LAWRENCE RIVER PROJECT

**CORNWALL CANAL RELOCATION**

**RECORD OF EXPLORATION**

**NO. 1**

IN SHEETS SHEET NO 1 SCALE 1" = 10 FT.

10 0 10 20

US ENGINEER OFFICE, MASSENA, NY FEBRUARY 12, 1942

SUBMITTED R. M. Hamer ENGINEER

RECOMMENDED HEAD ENGR.

LT. COL. CORPS OF ENGINEERS

APPROVED COL. CORPS OF ENGINEERS DISTRICT ENGINEER

DRAWN BY: FHA

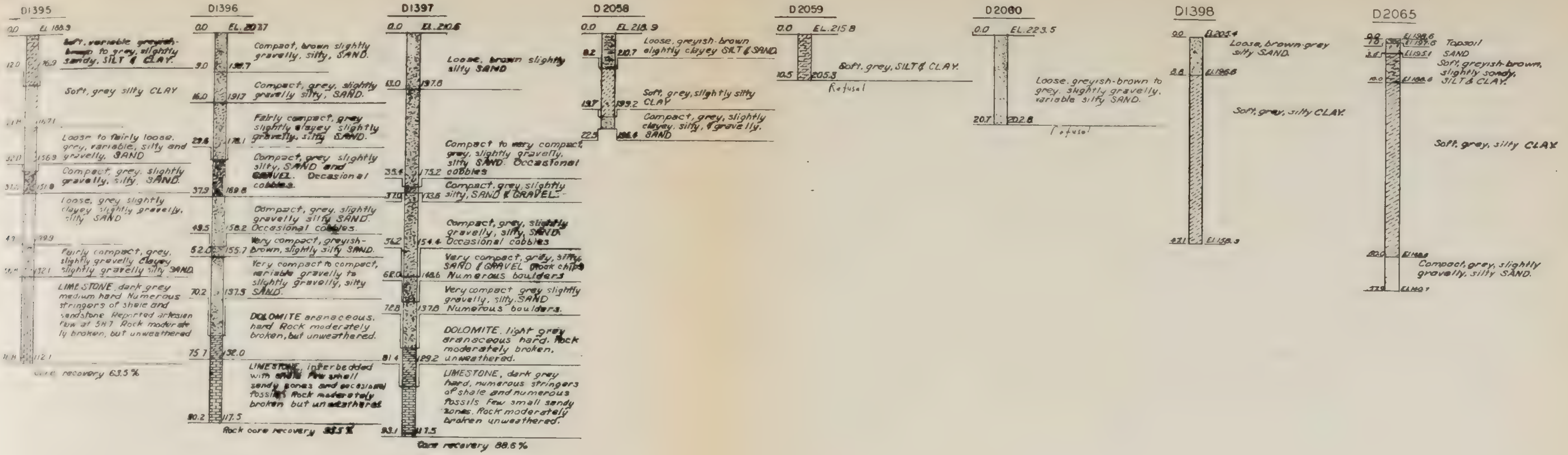
CHECKED BY: GCB.

BC-A-2/3 FILE NO.

TRANSMITTED WITH LETTER OR ENDORSEMENT

DATED 1942

PLATE 3


D1395
0.0 EL. 188.9
Soft, variable greyish-brown to grey, slightly sandy, SILT & CLAY.
12.0 176.9
Soft, grey silty CLAY
167.1
Loose to fairly loose, grey, variable, silty and gravelly, SAND
32.0 156.9
Compact, grey, slightly gravelly, silty, SAND.
151.8
loose, grey slightly clayey slightly gravelly, silty SAND
139.9
Fairly compact, grey, slightly gravelly clayey slightly gravelly silty SAND
132.1
LIMESTONE, dark grey medium hard Numerous stringers of shale and sandstone Reported artesian flow at 58.7 Rock moderately broken, but unweathered
112.1
Core recovery 63.5 %
D1396
0.0 EL. 207.7
Compact, brown slightly gravelly, silty, SAND.
9.0 198.7
Compact, grey, slightly gravelly silty, SAND.
16.0 191.7
Fairly compact, grey slightly clayey slightly gravelly, silty SAND.
29.6 178.1
Compact, grey slightly silty, SAND and GRAVEL. Occasional cobbles.
37.9 169.8
Compact, grey, slightly gravelly silty SAND. Occasional cobbles.
49.5 158.2
Very compact, greyish-brown, slightly silty SAND.
52.0 155.7
Very compact to compact, variable gravelly to slightly gravelly, silty SAND.
70.2 137.5
DOLOMITE arenaceous, hard Rock moderately broken, but unweathered.
75.7 132.0
LIMESTONE, interbedded with shale Few small sandy zones and occasional fossils Rock moderately broken but unweathered
80.2 117.5
Rock core recovery
D1397
0.0 EL. 210.6
Loose, brown slightly silty SAND
13.0 197.6
Compact to very compact, grey, slightly gravelly, silty SAND. Occasional cobbles
35.4 175.2
Compact, grey, slightly silty, SAND & GRAVEL.
37.0 173.6
Compact, grey, slightly gravelly, silty, SAND. Occasional cobbles
56.2 154.4
Very compact, grey, silty SAND & GRAVEL Rock chips Numerous boulders
62.0 148.6
Very compact grey slightly gravelly, silty SAND Numerous boulders.
72.8 137.8
DOLOMITE, light grey arenaceous hard. Rock moderately broken, unweathered.
81.4 129.2
LIMESTONE, dark grey hard, numerous stringers of shale and numerous fossils Few small sandy zones. Rock moderately broken unweathered.
93.1 117.5
Core recovery 88.6 %
D 2058
0.0 EL. 218.9
Loose, greyish-brown slightly clayey SILT & SAND.
8.2 210.7
Soft, grey, slightly silty CLAY
19.7 199.2
Compact, grey, slightly clayey, silty, & gravelly, SAND
22.5
D 2059
0.0 EL. 215.8
Soft, grey, SILT & CLAY.
10.5 205.3
Refusal
D 2060
0.0 EL. 223.5
Loose, greyish-brown to grey, slightly gravelly, variable silty SAND.
20.7 202.8
Refusal
D1398
0.0 El. 205.4
Loose, brown-grey silty SAND.
8.8 El. 196.6
Soft, grey, silty CLAY.
47.1 El. 158.3
D2065
0.0 El. 198.6
1.0 El. 197.6 Topsoil
3.5 El. 195.1 SAND
Soft, greyish-brown, slightly sandy, SILT & CLAY.
10.0 El. 188.6
Soft, grey, silty CLAY
Compact, grey, slightly gravelly, silty SAND.

For descriptive terms see BC-A-2/3

NOTE

Except wher noted Wash Boring analyses of overburden materia are based on dry sampling
Analyses of rock are based on cores obtained from drilling
Elevations based on Mean Sea Level datum, 1912 adj.

| TRANSVERSE MERCATOR COORDINATE | | |
|---|---|---|
| [illegible] | NORTH | EAST |
| [illegible] | [illegible],559 | [illegible] |
| [illegible] | [illegible],651 | [illegible],002 |
| [illegible] | 1,827,[illegible] | 360,623 |
| [illegible] | [illegible] | [illegible] 971 |
| [illegible] | [illegible],865 | 372,265 |
| [illegible] | [illegible] | [illegible],359 |
| [illegible] | [illegible] | [illegible],400 |
| [illegible] | 1,820,000 | [illegible] |

ST LAWRENCE RIVER PROJECT

# CORNWALL CANAL RELOCATION
## RECORD OF FOUNDATION EXPLORATION
NO. 2

IN SHEETS SHEET NO 2 SCALE 1" = 10'

10 0 10 20

U. S. ENGINEER OFFICE MASSENA NEW YORK FEB 1942

SUBMITTED R. M. Haynes ENGINEER

RECOMMENDED HEAD ENGR. LT COL CORPS OF ENGINEERS

APPROVED CORPS OF ENGINEERS

DRAWN BY

CHECKED BY G.E.B.

FILE NO BC-A-2/4

TRANSMITTED WITH LETTER OR ENDORSEMENT

DATED 194

PLATE 4

# ST. LAWRENCE RIVER

## PROBING RESULTS - CORNWALL CANAL RELOCATION

| Probing No. Coordinates and Surface Elevation | Depth in Feet | Blows per Foot | Samples No. | Samples Depth | Description of Samples |
|---|---|---|---|---|---|
| PH-4524 | | | | | |
| N. 1,829,838 | 0-2 | 6 | $S_1$ | 7.6 | Silty SAND |
| E. 378,128 | 2-4 | 32 | | | |
| El. 213.5 | 4-5 | 121 | | | |
| | 5-8 | 103 | | | |
| | 8-8.7 | 415 | | | |
| | No Refusal | | | | |
| PH-4525 | | | | | |
| N. 1,830,025 | 0-2 | 5 | $S_1$ | 7.6 | Silty CLAY |
| E. 378,534 | 2-5 | 12 | $S_2$ | 13.6 | Silty CLAY |
| El. 212.8 | 5-15 | 3 | $S_3$ | 20.6 | SILT & SAND |
| | 15-20 | 14 | | | |
| | 20-21 | 70 | | | |
| | 21-21½ | 393 | | | |
| | No Refusal | | | | |
| PH-4526 | | | | | |
| N. 1,829,588 | 0-3 | 4 | $S_1$ | 7.6 | SILT & SAND |
| E. 378,440 | 3-12 | 10 | $S_2$ | 13.6 | SILT & CLAY |
| El. 210.9 | 12-26 | 5 | $S_3$ | 20.6 | Silty CLAY |
| | 26-31 | 21 | $S_4$ | 26.6 | SILT & CLAY |
| | 31-33 | 93 | | | |
| | 33-36 | 41 | | | |
| | 36-38 | 217 | | | |
| | No Refusal | | | | |
| PH-4527 | | | | | |
| N. 1,830,087 | 0-2 | 4 | $S_1$ | 7.6 | Silty SAND |
| E. 379,096 | 2-5 | 13 | $S_2$ | 13.6 | Silty CLAY |
| El. 211.2 | 5-32 | 5 | $S_3$ | 20.6 | Silty CLAY |
| | 32-34 | 14 | $S_4$ | 26.6 | Silty CLAY |
| | 34-43 | 29 | $S_5$ | 33.6 | Sandy SILT & CLAY |
| | 43-43.8 | 150 | $S_6$ | 39.6 | Silty SAND |
| | Refusal | | | | |
| PH-4528 | | | | | |
| N. 1,829,338 | 0-40 | 6 | $S_1$ | 13.6 | Silty SAND |
| E. 378,752 | 40-51 | 14 | $S_2$ | 27.6 | Silty CLAY |
| El. 209.8 | 51-56 | 27 | $S_3$ | 40.6 | Silty CLAY |
| | 56-57.7 | 55 | $S_4$ | 47.6 | Silty CLAY |
| | Refusal | | | | |
| PH-4529 | | | | | |
| N. 1,829,650 | 0-8 | 6 | $S_1$ | 13.6 | SAND |
| E. 379,002 | 8-10 | 15 | $S_2$ | 27.6 | Silty SAND |
| El. 209.7 | 10-40 | 6 | $S_3$ | 40.6 | Sandy SILT & CLAY |
| | 40-49 | 12 | | | |
| | 49-55 | 27 | | | |
| | 55-55.6 | 50 | | | |
| | Refusal | | | | |
| PH-4530 | | | | | |
| N. 1,829,049 | 0-30 | 5 | $S_1$ | 13.6 | SILT & CLAY |
| E. 378,648 | 30-37 | 23 | $S_2$ | 27.6 | SILT & CLAY |
| El. 198.0 | 37-38.9 | 48 | $S_3$ | 34.6 | Clayey, Silty SAND |
| | Refusal | | | | |
| PH-4531 | | | | | |
| N. 1,829,899 | 0-40.6 | 5 | $S_1$ | 13.6 | Sandy SILT & CLAY |
| E. 379,330 | 40.6-52 | 12 | $S_2$ | 27.6 | Silty CLAY |
| El. 209.7 | 52-53.5 | 35 | $S_3$ | 40.6 | Silty CLAY |
| | Refusal | | $S_4$ | 47.6 | Silty CLAY |
| PH-4532 | | | | | |
| N. 1,830,211 | 0-3 | 4 | $S_1$ | 13.6 | SILT & CLAY |
| E. 379,581 | 3-6 | 14 | $S_2$ | 27.6 | Silty CLAY |
| El. 209.8 | 6-16 | 8 | $S_3$ | 40.6 | Silty CLAY |
| | 16-47 | 6 | $S_4$ | 47.6 | Silty CLAY |
| | 47-55 | 10 | $S_5$ | 53.6 | Silty CLAY |
| | 55-56.9 | 26 | | | |
| | Refusal | | | | |
| PH-4533 | | | | | |
| N. 1,829,212 | 0-10 | 7 | $S_1$ | 13.6 | SILT & SAND |
| E. 378,908 | 10-11 | 20 | $S_2$ | 27.6 | Silty SAND |
| El. 207.9 | 11-49 | 7 | $S_3$ | 40.6 | SILT & CLAY |
| | 49-49.9 | 14 | | | |
| | Refusal | | | | |
| PH-4534 | | | | | |
| N. 1,829,524 | 0-3 | 4 | $S_1$ | 13.6 | Slightly Silty SAND |
| E. 379,158 | 3-5 | 13 | $S_2$ | 27.6 | Silty SAND |
| El. 209.6 | 5-18 | 8 | $S_3$ | 40.6 | SILT & CLAY |
| | 18-42 | 5 | $S_4$ | 47.6 | Silty CLAY |
| | 42-56.1 | 12 | | | |
| | 56.1- | 50 | | | |
| | Refusal | | | | |
| PH-4535 | | | | | |
| N. 1,829,043 | 0-13 | 4 | $S_1$ | 13.6 | SILT & CLAY |
| E. 378,900 | 13-36 | 17 | $S_2$ | 27.6 | SILT & CLAY |
| El. 195.4 | Refusal | | $S_3$ | 34.6 | Silty CLAY |
| PH-4536 | | | | | |
| N. 1,829,784 | 0-48.6 | 3 | $S_1$ | 7.6 | SILT & CLAY |
| E. 379,486 | 48.6-49.8 | 33 | $S_2$ | 20.6 | SILT & CLAY |
| El. 204.4 | Refusal | | $S_3$ | 34.6 | SILT & CLAY |
| | | | $S_4$ | 48.6 | SILT & CLAY |
| PH-4537 | | | | | |
| N. 1,830,086 | 0-51 | 3 | $S_1$ | 7.6 | SAND & SILT |
| E. 379,737 | 51-52 | 17 | $S_2$ | 13.6 | SAND & SILT |
| El. 205.5 | 52-52.2 | [illegible] | $S_3$ | 20.6 | SAND & SILT |
| | Refusal | | $S_4$ | 27.6 | SILT & CLAY |
| | | | $S_5$ | 33.6 | SILT & CLAY |
| | | | $S_6$ | 40.6 | SILT & CLAY |
| | | | $S_7$ | 47.6 | SILT & CLAY |
| PH-4538 | | | | | |
| N. 1,839,398 | 0-50.6 | 3 | $S_1$ | 13.6 | Sandy SILT & CLAY |
| E. 379,987 | Refusal | | $S_2$ | 27.6 | SILT & CLAY |
| El. 203.1 | | | $S_3$ | 40.6 | Silty CLAY |
| | | | $S_4$ | 47.6 | Silty CLAY |
| PH-4539 | | | | | |
| N. 1,829,093 | 0-8 | 6 | $S_1$ | 13.6 | Sandy SILT & CLAY |
| E. 379,056 | 8-34.1 | 17 | $S_2$ | 27.6 | SILT & CLAY |
| El. 194.3 | Refusal | | | | |
| PH-4540 | | | | | |
| N. 1,829,399 | 0-36 | 5 | $S_1$ | 13.6 | SILT & CLAY |
| E. 379,314 | 36-44.5 | 11 | $S_2$ | 27.6 | Silty CLAY |
| El. 200.7 | Refusal | | $S_3$ | 34.6 | Silty CLAY |
| | | | $S_4$ | 40.6 | Silty CLAY |
| PH-4541 | | | | | |
| N. 1,829,649 | 0-13 | 5 | $S_1$ | 13.6 | Sandy SILT & CLAY |
| E. 379,642 | 13-38.5 | 9 | $S_2$ | 27.6 | SILT & CLAY |
| El. 196.4 | Refusal | | | | |
| PH-4542 | | | | | |
| N. 1,829,961 | 0-31 | 7 | $S_1$ | 13.6 | SILT & CLAY |
| E. 379,893 | 31-36 | 95 | $S_2$ | 27.6 | Silty CLAY |
| El. 198.9 | 36-36.8 | 300 | $S_3$ | 34.6 | SILT & SAND |
| | Refusal | | | | |
| PH-4543 | | | | | |
| N. 1,830,273 | 0-51.7 | 3 | $S_1$ | 13.6 | Silty CLAY |
| E. 380,143 | 51.7- | | $S_2$ | 27.6 | Silty CLAY |
| El. 202.9 | Refusal | | $S_3$ | 34.6 | SILT & CLAY |
| | | | $S_4$ | 40.6 | SILT & CLAY |
| | | | $S_5$ | 47.6 | Silty CLAY |
| PH-4544 | | | | | |
| N. 1,828,975 | 0-7 | 4 | $S_1$ | 13.6 | SILT & CLAY |
| E. 373,204 | 7-18 | 11 | $S_2$ | 27.6 | SILT & CLAY |
| El. 196.8 | 18-27 | 8 | | | |
| | 27-33.2 | 16 | | | |
| | Refusal | | | | |
| PH-4545 | | | | | |
| N. 1,828,852 | 0-43 | 5 | $S_1$ | 13.6 | Sandy SILT & CLAY |
| E. 379,138 | 43-48.7 | 17 | $S_2$ | 26.6 | SILT & CLAY |
| El. 203.2 | Refusal | | $S_3$ | 40.6 | SILT & CLAY |
| PH-4546 | | | | | |
| N. 1,829,836 | 0-27 | [illegible] | $S_1$ | 13.6 | Silty CLAY |
| E. 380,049 | 27-28 | 206 | $S_2$ | 27.4 | Silty CLAY |
| El. 198.8 | No Refusal | | | | |
| PH-4547 | | | | | |
| N. 1,830,116 | 0-38 | 4 | $S_1$ | 13.6 | SILT & CLAY |
| E. 380,338 | 38-39 | 21 | $S_2$ | 26.6 | Silty CLAY |
| El. 199.7 | 39-39.9 | 80 | $S_3$ | 39.9 | Silty SAND |
| | Refusal | | | | |
| PH-4548 | | | | | |
| N. 1,828,631 | 0-39 | 4 | $S_1$ | 13.6 | Sandy SILT & CLAY |
| E. 379,184 | 39-41.8 | 23 | $S_2$ | 26.6 | SILT & CLAY |
| El. 204.3 | Refusal | | $S_3$ | 39.6 | SILT & CLAY |
| PH-4549 | | | | | |
| N. 1,828,849 | 0-2 | 4 | $S_1$ | 13.6 | SILT & CLAY |
| E. 379,360 | 2-4 | 15 | $S_2$ | 26.6 | Silty CLAY |
| El. 207.1 | 4-47 | 6 | $S_3$ | 40.6 | Silty CLAY |
| | 47-50 | 21 | | | |
| | 50-51 | 42 | | | |
| | 51-51.8 | 100 | | | |
| | Refusal | | | | |
| PH-4550 | | | | | |
| N. 1,829,461 | 0-28.1 | 4 | $S_1$ | 13.6 | Silty CLAY |
| E. 397,876 | Refusal | | $S_2$ | 20.6 | SAND & SILT |
| El. 205.8 | | | $S_3$ | 26.6 | SILT & CLAY |
| PH-4551 | | | | | |
| N. 1,829,710 | 0-21 | 4 | $S_1$ | 13 6<br>12.6 | SILT & SAND |
| E. 380,205 | 21-32 | 39 | $S_2$ | 33.6 | SAND |
| El. 209.6 | 32-33 | 84 | | | |
| | 33-40 | 51 | | | |
| | 40-42 | 167 | | | |
| | No Refusal | | | | |
| PH-4552 | | | | | |
| N. 1,828,460 | 0-26 | 3 | $S_1$ | 13.6 | SILT & CLAY |
| E. 379,239 | 26-34 | 14 | $S_2$ | 26.6 | SILT & CLAY |
| El. 200.9 | 34-36 | 60 | | | |
| | 36-39 | 187 | | | |
| | No Refusal | | | | |

File No. BC-A-2/5

Plate 5

# ST. LAWRENCE RIVER

## PROBING RESULTS - CORNWALL CANAL RELOCATION

| Probing No. Coordinates and Surface Elevation | Depth in Feet | Blows per Foot | Samples No. | Samples Depth | Description of Samples |
|---|---|---|---|---|---|
| PH-4553 | | | | | |
| N. 1,829,336 | 0-2 | 3 | $S_1$ | 13.6 | SILT & CLAY |
| E. 380,032 | 2-4 | 12 | $S_2$ | 20.6 | NO SAMPLE |
| El. 211.9 | 4-15 | 4 | | | |
| | 15-18 | 14 | | | |
| | 18-20 | 40 | | | |
| | 20-23 | 24 | | | |
| | 23-25 | 100 | | | |
| | 25-26 | 262 | | | |
| | No Refusal | | | | |
| PH-4554 | | | | | |
| N. 1,829,585 | 0-2 | 4 | $S_1$ | 7.6 | Clayey SAND & SILT |
| E. 380,361 | 2-6 | 10 | $S_2$ | | |
| El. 212.4 | 6-15.2 | 4 | | | |
| | No Refusal | | | | |
| PH-4555 | | | | | |
| N. 1,829,211 | 0-2 | 6 | $S_1$ | 13.6 | SILT & CLAY |
| E. 380,188 | 2-5 | 19 | $S_2$ | 26.6 | SAND & SILT |
| El. 213.4 | 5-25 | 5 | | | |
| | 25-27.4 | 25 | | | |
| | Refusal | | | | |
| PH-4556 | | | | | |
| N. 1,828,430 | 0-22 | 6 | $S_1$ | 13.6 | Sandy SILT & CLAY |
| E. 379,883 | 22-28 | 25 | $S_2$ | 22.6 | SAND & SILT |
| El. 211.0 | 28-30 | 50 | | | |
| | 30-30.5 | 184 | | | |
| | Refusal | | | | |
| PH-4557 | | | | | |
| N. 1,828,960 | 0-2 | 4 | | | |
| E. 380,500 | 2-3 | 10 | | | |
| El. 213.8 | 3-5 | 4 | | | |
| | 5-7 | 1 | | | |
| | 7-9 | 7 | | | |
| | 9-10 | 123 | | | |
| | 10-11 | 340 | | | |
| | No Refusal | | | | |
| PH-4573 | | | | | |
| N. 1,830,578 | 0-54.5 | 3 | $S_1$ | 13.6 | Silty CLAY |
| E. 380,242 | 54.5- | | $S_2$ | 27.6 | Silty CLAY |
| El. 208.3 | Refusal | | $S_3$ | 40.6 | Silty CLAY |
| | | | $S_4$ | 53.6 | Silty CLAY |
| PH-4574 | | | | | |
| N. 1,830,453 | 0-39.5 | [illegible] | $S_1$ | 13.6 | SILT & CLAY |
| E. 380,398 | Refusal | | $S_2$ | 27.6 | SILT & CLAY |
| El. 195.1 | | | | | |
| PH-4575 | | | | | |
| N. 1,830,328 | 0-52.4 | 4 | $S_1$ | 13.6 | Silty CLAY |
| E. 380,554 | Refusal | | $S_2$ | 27.6 | Silty CLAY |
| El. 203.6 | | | $S_3$ | 40.6 | Silty CLAY |
| PH-4576 | | | | | |
| N. 1,830,830 | 0-52 | 4 | $S_1$ | 13.6 | Silty CLAY |
| E. 380,407 | 52-55 | 15 | $S_2$ | 27.6 | Silty CLAY |
| El. 205.7 | 55-57 | 42 | $S_3$ | 40.6 | Silty CLAY |
| | 57-57.6 | 133 | $S_4$ | 53.6 | Clayey SAND & SILT |
| | Refusal | | | | |
| PH-4577 | | | | | |
| N. 1,830,705 | 0-44.0 | 3 | $S_1$ | 13.6 | SILT & CLAY |
| E. 380,563 | Refusal | | $S_2$ | 26.6 | Silty CLAY |
| El. 197.0 | | | | | |
| PH-4578 | | | | | |
| N. 1,830,580 | 0-48 | 6 | $S_1$ | 13.6 | Silty CLAY |
| E. 380,719 | 48-50 | 27 | $S_2$ | 27.6 | Silty CLAY |
| El. 203.8 | 50-51.4 | 50 | $S_3$ | 40.6 | Silty CLAY |
| | Refusal | | | | |
| PH-4579 | | | | | |
| N. 1,831,108 | 0-35.4 | 4 | $S_1$ | 13.6 | Silty CLAY |
| E. 380,540 | Refusal | | $S_2$ | 27.6 | Silty CLAY |
| El. 203.8 | | | | | |
| PH-4580 | | | | | |
| N. 1,830,983 | 0-32.3 | 3 | $S_1$ | 13.6 | Silty CLAY |
| E. 380,696 | Refusal | | $S_2$ | 27.6 | Silty CLAY |
| El. 198.6 | | | | | |
| PH-4581 | | | | | |
| N. 1,830,858 | 0-39 | 6 | $S_1$ | 13.6 | Silty CLAY |
| E. 380,852 | 39-42 | 25 | $S_2$ | 27.6 | Silty CLAY |
| El. 204.7 | 42-44.9 | 65 | $S_3$ | 40.6 | Clayey SAND & SILT |
| | Refusal | | | | |
| PH-4582 | | | | | |
| N. 1,831,315 | 0-26.5 | 4 | $S_1$ | 13.6 | Silty CLAY |
| E. 380,729 | Refusal | | | | |
| El. 202.3 | | | | | |
| PH-4583 | | | | | |
| N. 1,831,238 | 0-21.6 | 4 | $S_1$ | 13.6 | Silty CLAY |
| E. 380,854 | Refusal | | $S_2$ | 20.6 | Silty CLAY |
| El. 199.0 | | | | | |
| PH-4584 | | | | | |
| N. 1,831,132 | 0-8 | 4 | $S_1$ | 13.6 | Silty CLAY |
| E. 381,024 | 8-9 | 15 | | | |
| El. 204.9 | 9-20.1 | 7 | | | |
| | Refusal | | | | |
| PH-4585 | | | | | |
| N. 1,831,387 | 0-22.2 | 6 | $S_1$ | 13.6 | Silty CLAY |
| E. 381,183 | Refusal | | | | |
| El. 204.0 | | | | | |
| PH-4586 | | | | | |
| N. 1,830,777 | 0-26.1 | [illegible] | $S_1$ | 7.6 | Sandy SILT |
| E. 380,957 | Refusal | | $S_2$ | 13.6 | Silty CLAY |
| El. 205.3 | | | $S_3$ | 20.6 | Silty CLAY |
| PH-4591 | | | | | |
| N. 1,829,586 | 0-2 | 5 | $S_1$ | 7.6 | Silty CLAY |
| E. 380,998 | 2-3 | 15 | | | |
| El. 211.3 | 3-11 | 5 | | | |
| | 11-12.9 | 40 | | | |
| | Refusal | | | | |
| PH-4592 | | | | | |
| N. 1,829,772 | 0-26 | 4 | $S_1$ | 7.6 | Silty SAND |
| E. 380,767 | 26-27 | 27 | $S_2$ | 13.6 | Silty CLAY |
| El. 211.7 | 27-36 | 8 | $S_3$ | 26.6 | Silty CLAY |
| | 36-36.5 | 16 | $S_4$ | 33.6 | Silty CLAY |
| | Refusal | | | | |
| PH-4593 | | | | | |
| N. 1,829,930 | 0-54.5 | 4 | $S_1$ | 13.6 | Silty CLAY |
| E. 380,570 | Refusal | | $S_2$ | 26.6 | Silty CLAY |
| El. 208.4 | | | $S_3$ | 39.6 | Silty CLAY |
| | | | $S_4$ | 46.6 | Silty CLAY |
| PH-4594 | | | | | |
| N. 1,830,690 | 0-29 | 7 | $S_1$ | 13.6 | Silty CLAY |
| E. 379,623 | 29-40.6 | 14 | $S_2$ | 26.6 | Silty CLAY |
| El. 210.2 | Refusal | | $S_3$ | 32.6 | SILT & CLAY |
| PH-4595 | | | | | |
| N. 1,830,872 | 0-2 | 8 | $S_1$ | 7.6 | Silty CLAY |
| E. 379,440 | 2-5 | 15 | $S_2$ | 20.6 | Silty SAND |
| El. 212.0 | 5-15 | 4 | $S_3$ | 26.6 | SAND & SILT |
| | 15-26.6 | 18 | | | |
| | 26.6-31.6 | 57 | | | |
| | Refusal | | | | |
| PH-4596 | | | | | |
| N. 1,830,900 | 0-5 | 7 | $S_1$ | 7.6 | Clayey SAND & SILT |
| E. 379,387 | 5-8 | 14 | $S_2$ | 13.6 | SILT & SAND |
| El. 210.1 | 8-14 | [illegible] | | | |
| | 14-16 | 32 | | | |
| | 16-19 | 59 | | | |
| | 19-20 | 206 | | | |
| | No Refusal | | | | |
| PH-4597 | | | | | |
| N. 1,830,888 | 0-2 | 4 | | | First attempt - |
| E. 379,315 | 2-3 | 21 | | | Refusal - 1.8 |
| El. 213.4 | 3-4 | 76 | | | |
| | 4-5 | 231 | | | |
| | No Refusal | | | | |
| PH-4598 | | | | | |
| N. 1,830,680 | 0-24 | 5 | $S_1$ | 7.6 | Sandy SILT |
| E. 381,081 | 24-27.9 | 26 | $S_2$ | 13.6 | Silty CLAY |
| El. 206.9 | Refusal | | $S_3$ | 20.6 | Silty CLAY |
| | | | $S_4$ | 26.6 | SAND |
| PH-4599 | | | | | |
| N. 1,830,555 | 0-2 | 3 | $S_1$ | 7.6 | Sandy SILT & CLAY |
| E. 381,237 | 2-5 | 11 | $S_2$ | 13.6 | Silty CLAY |
| El. 212.1 | 5-21 | 6 | $S_3$ | .19.6 | Silty CLAY |
| | 21-23 | 104 | | | |
| | 23-23.6 | 350 | | | |
| | No Refusal | | | | |
| PH-4600 | | | | | |
| N. 1,834,320 | 0-2 | 4 | S1 | 7.6 | Silty SAND |
| E. 371,804 | 2-13 | 40 | S2 | 13.6 | Silty SAND |
| El. 223.0 | 13-13.6 | 270 | | | |
| | Refusal | | | | |
| PH-4601 | | | | | |
| N. 1,834,518 | 0-4 | 5 | S1 | 7.6 | Silty SAND |
| E. 371,826 | 4-7 | 28 | S2 | 13.2 | SAND |
| El. 221.8 | 7-10 | 15 | | | |
| | 10-13 | 30 | | | |
| | 13-13.5 | 424 | | | |
| | Refusal | | | | |
| PH-4602 | | | | | |
| N. 1,834,717 | 0-6 | 4 | | | |
| E. 371,848 | 6-8 | 32 | | | |
| El. 221.4 | 8-11 | 100 | | | |
| | 11-11.4 | 20[illegible] | | | |
| | Refusal | | | | |
| PH-4603 | | | | | |
| N. 1,835,115 | 0-7 | 4 | S1 | 7.6 | CLAY & SILT |
| E. 371,893 | 7-20 | 10 | S2 | 13.6 | SILT & CLAY |
| El. 219.2 | 20-22.6 | 18 | S3 | 20.6 | Clayey SILT & SAND |
| | Refusal | | | | |

File No. BC-A-2/6
Plate 6

## ST. LAWRENCE RIVER

## PROBING RESULTS - CORNWALL CANAL RELOCATION

| Probing No. Coordinates and Surface Elevation | Depth in Feet | Blows per Feet | Samples No. | Samples Depth | Description of Samples |
|---|---|---|---|---|---|
| PH-4604 | | | | | |
| N. 1,835,314 | 0-27.4 | 5 | S1 | 7.6 | Silty SAND |
| E. 371,915 | Refusal | | S2 | 13.6 | Sandy CLAY & SILT |
| EL. 218.6 | | | S3 | 20.6 | Silty CLAY |
| | | | S4 | 27.4 | Silty SAND |
| PH-4605 | | | | | |
| N. 1,835,512 | 0-22 | 6 | S1 | 7.6 | SAND & SILT |
| E. 371,937 | 22-24 | 25 | S2 | 13.6 | Silty SAND |
| EL. 219.8 | 24-25 | 138 | S3 | 20.6 | Clayey, SAND & SILT |
| | 25-27 | 70 | | | |
| | Refusal | | | | |
| PH-4606 | | | | | |
| N. 1,834,286 | 0-18 | 6 | S1 | 7.6 | Silty CLAY |
| E. 372,102 | 18-19 | 26 | S2 | 13.6 | Silty CLAY |
| EL. 216.2 | 19-20 | 80 | | | |
| | Refusal | | | | |
| PH-4607 | | | | | |
| N. 1,834,485 | 0-15 | 5 | S1 | 7.6 | Silty CLAY |
| E. 372,124 | 15-22 | 30 | S2 | 13.6 | Sandy SILT & CLAY |
| EL. 218.0 | 22-23 | 93 | S3 | 20.2 | SAND & GRAVEL |
| | Refusal | | | | |
| PH-4608 | | | | | |
| N. 1,834,684 | 0-20 | 5 | S1 | 7.6 | Silty CLAY |
| E. 372,147 | 20-23 | 15 | S2 | 13.6 | Silty CLAY |
| EL. 218.9 | 23-23.5 | 34 | S3 | 20.6 | Sandy, SILT & CLAY |
| | Refusal | | | | |
| PH-4609 | | | | | |
| N. 1,834,883 | 0-20 | 5 | S1 | 7.6 | Sandy SILT |
| E. 372,169 | 20-23 | 15 | S2 | 13.6 | Silty CLAY |
| EL. 219.6 | 23-24.6 | 60 | S3 | 20.6 | Clayey SAND & SILT |
| | Refusal | | | | |
| PH-4610 | | | | | |
| N. 1,835,081 | 0-19 | 5 | S1 | 7.6 | Silty SAND |
| E. 372,191 | 19-24. | 25 | S2 | 13.6 | Silty CLAY |
| EL. 220.3 | 24-24.4 | 70 | S3 | 19.6 | SAND |
| | Refusal | | | | |
| PH-4611 | | | | | |
| N. 1,835,280 | 0-23 | [illegible] | S1 | 7.6 | Sandy, Clayey SILT |
| E. 372,213 | 23.25 | [illegible] | S2 | 13.6 | SILT & CLAY |
| EL. 220.8 | 25-25.5 | 40 | S3 | 20.6 | SILT & CLAY |
| | Refusal | | | | |
| PH-4612 | | | | | |
| N. 1,835,479 | 0-4 | 5 | S1 | 7.6 | Silty SAND |
| E. 372,236 | 4-6 | 15 | S2 | 13.6 | Silty CLAY |
| EL. 219.7 | 6-26 | 4 | S3 | 20.6 | Silty CLAY |
| | 26-26.8 | 15 | | | |
| | Refusal | | | | |
| PH-4613 | | | | | |
| N. 1,835,446 | 0-16 | 5 | S1 | 7.6 | SAND & SILT |
| E. 372,534 | 16-17 | 26 | S2 | 13.6 | Silty CLAY |
| EL. 214.6 | 17-19 | 92 | S3 | 20.4 | Silty SAND |
| | 19-24 | 35 | | | |
| | 24-26.8 | [illegible] | | | |
| | Refusal | | | | |
| PH-4614 | | | | | |
| N. 1,835,247 | 0-15.3 | 5 | S1 | 7.6 | Silty CLAY |
| E. 372,512 | Refusal | | S2 | 13.6 | Silty CLAY |
| EL. 217.6 | | | | | |
| PH-4615 | | | | | |
| N. 1,835,048 | 0-21 | 6 | S1 | 7.6 | Sandy SILT & CLAY |
| E. 372,489 | 21-24 | 20 | S2 | 13.6 | Silty CLAY |
| EL. 219.0 | 24-25.9 | 35 | S3 | 20.6 | Silty CLAY |
| | Refusal | | | | |
| PH-4616 | | | | | |
| N. 1,834,849 | 0-5 | 5 | S1 | 7.4 | Silty SAND |
| E. 372,467 | 5-7 | 75 | | | |
| EL. 222.3 | 7-11 | 160 | | | |
| | No Refusal | | | | |
| PH-4617 | | | | | |
| N. 1,834,650 | 0-8 | 7 | S1 | 7.6 | Silty SAND |
| E. 372,446 | 8-12 | 24 | S2 | 13.4 | Sandy SILT & CLAY |
| EL. 219.9 | 12-13 | 73 | | | |
| | 13-16 | 45 | | | |
| | 16-19 | 60 | | | |
| | 19-19.3 | 170 | | | |
| | Refusal | | | | |
| PH-4618 | | | | | |
| N. 1,834,452 | 0-11.4 | 5 | S1 | 7.6 | Silty SAND (SHELLS) |
| E. 372,422 | Refusal | | | | |
| EL. 220.0 | | | | | |
| PH-4619 | | | | | |
| N. 1,834,380 | 0-14 | 7 | S1 | 7.6 | Silty CLAY |
| E. 1,834,253 | 14-17 | 13 | S2 | 13.6 | Silty CLAY |
| EL. 221.4 | 17-18 | 39 | | | |
| | 18-18.8 | 160 | | | |
| | Refusal | | | | |
| PH-4620 | | | | | |
| N. 1,834,220 | 0-14 | 5 | S1 | 7.6 | Clayey SAND & SILT |
| E. 372,598 | 14-17 | 13 | S2 | 13.6 | Silty CLAY |
| EL. 222.7 | 17-18 | 31 | | | |
| | 18-20.3 | 70 | | | |
| | Refusal | | | | |
| PH-4621 | | | | | |
| N. 1,834,418 | 0-4 | 4 | S1 | 7.6 | SAND & SILT |
| E. 372,721 | 4-7 | 11 | S2 | 13.6 | Silty SAND |
| EL. 223.8 | 7-13 | 4 | | | |
| | 13-17 | 20 | | | |
| | 17-17.8 | 130 | | | |
| | Refusal | | | | |
| PH-4622 | | | | | |
| N. 1,834,617 | 0-3 | 6 | | | |
| E. 372,743 | 3-4 | [illegible] | | | |
| EL. 225.8 | 4-5 | 54 | | | |
| | 5-5.8 | 200 | | | |
| | Refusal | | | | |
| PH-4623 | | | | | |
| N. 1,834,816 | 0-4 | 4 | | | |
| E. 372,765 | 4-5 | 61 | | | |
| EL. 224.1 | 5-6 | 230 | | | |
| | No Refusal | | | | |
| PH-4624 | | | | | |
| N. 1,835,015 | 0-4 | 3 | S1 | 7.6 | Silty SAND |
| E. 372,787 | 4-7 | 12 | | | |
| EL. 222.3 | 7-8 | 70 | | | |
| | 8-13 | 25 | | | |
| | 13-13.3 | 140 | | | |
| | Refusal | | | | |
| PH-4625 | | | | | |
| N. 1,835,213 | 0-3 | 4 | S1 | 7.6 | Silty SAND |
| E. 372,810 | 3-6 | 13 | | | |
| EL. 225.2 | 6-8 | 50 | | | |
| | 8-8.6 | 210 | | | |
| | Refusal | | | | |
| PH-4626 | | | | | |
| N. 1,835,412 | 0-2 | 5 | | | |
| E. 372,832 | 2-3 | 36 | | | |
| EL. 229.4 | 3-6 | 180 | | | |
| | No Refusal | | | | |
| PH-4627 | | | | | |
| N. 1,834,186 | 0-8 | 4 | S1 | 7.6 | Sandy, SILT & CLAY |
| E. 372,997 | 8-9 | 33 | | | |
| EL. 223.9 | 9-10 | 211 | | | |
| | No Refusal | | | | |
| PH-4628 | | | | | |
| N. 1,830,364 | 0-7 | 4 | S1 | 13.6 | Sandy SILT & CLAY |
| E. 381,471 | 7-19 | 13 | S2 | 20.6 | Silty SAND |
| EL. 209.6 | 19-26 | 40 | | | |
| | 26-26.7 | 70 | | | |
| | Refusal | | | | |
| PH-4629 | | | | | |
| N. 1,830,314 | 0-7 | 6 | S1 | 13.6 | Silty SAND |
| E. 381,542 | 7-13 | 15 | | | |
| EL. 211.0 | 13-18 | 25 | | | |
| | 18-19.5 | 80 | | | |
| | Refusal | | | | |
| PH-4630 | | | | | |
| N. 1,830,259 | 0-5 | 5 | | | |
| E. 381,626 | 5-6 | 35 | | | |
| EL. 212.2 | 6-6.8 | 200 | | | |
| | Refusal | | | | |
| PH-4631 | | | | | |
| N. 1,831,441 | 0-8 | 6 | S1 | 7.6 | Sandy SILT & CLAY |
| E. 380,117 | 8-10 | 12 | | | |
| EL. 208.8 | 10-12 | 65 | | | |
| | 12-13 | 224 | | | |
| | No Refusal | | | | |
| PH-4632 | | | | | |
| N. 1,831,312 | 0-29.5 | 5 | S1 | 13.6 | SILT & CLAY |
| E. 380,280 | Refusal | | S2 | 27.6 | Silty CLAY |
| EL. 209.3 | | | | | |
| PH-4634 | | | | | |
| N. 1,828,391 | 0-3 | 4 | S1 | 7.6 | Silty SAND |
| E. 379,472 | 3-6 | 10 | S2 | 13.6 | Silty CLAY |
| EL. 211.0 | 6-24 | 5 | | | |
| | 24-24.5 | 18 | | | |
| | Refusal | | | | |
| PH-4635 | | | | | |
| N. 1,827,904 | 0-3 | 6 | | | |
| E. 379,792 | 3-6 | 60 | | | |
| EL. 199.9 | 6-7 | 100 | | | |
| | 7-7.8 | 280 | | | |
| | No Refusal | | | | |

ST. LAWRENCE RIVER

PROBING RESULTS - CORNWALL CANAL RELOCATION

| Probing No. Coordinates and Surface Elevation | Depth in Feet | Blows per Foot | Samples No. | Samples Depth | Description of Samples |
|---|---|---|---|---|---|
| PH-4636 | | | | | |
| N. 1,828,174 | 0-2 | 3 | S1 | 7.6 | Silty SAND |
| E. 379,922 | 2-7 | 12 | S2 | 13.6 | Clayey SILT & SAND |
| EL. 212.1 | 7-20 | 5 | S3 | 20.6 | SILT & CLAY |
| | 20-28 | 16 | S4 | 26.6 | Clayey SAND & SILT |
| | 28-29 | 215 | | | |
| | No Refusal | | | | |
| PH-4637 | | | | | |
| N. 1,829,402 | 0-27 | 5 | S1 | 7.6 | Silty SAND |
| E. 380,676 | 27-27.9 | 110 | S2 | 13.6 | Silty CLAY |
| EL. 211.5 | Refusal | | S3 | 20.6 | Silty CLAY |
| PH-4638 | | | | | |
| N. 1,827,680 | 0-14 | 6 | S1 | 7.6 | SAND & SILT |
| E. 380,251 | 14-24 | 35 | S2 | 13.6 | SAND & SILT |
| EL. 204.8 | 24-24.7 | 300 | S3 | 20.6 | SAND & GRAVEL |
| | No Refusal | | | | |
| PH-4639 | | | | | |
| N. 1,827,956 | 0-12 | 6 | S1 | 7.6 | Silty SAND |
| E. 380,373 | 12-17 | 12 | S2 | 13.6 | Clayey SAND & SILT |
| EL. 211.4 | 17-22 | 30 | S3 | 20.6 | Silty SAND |
| | 22-23 | 54 | | | |
| | 23-25 | 165 | | | |
| | No Refusal | | | | |
| PH-4640 | | | | | |
| N. 1,828,564 | 0-4 | 5 | | | |
| E. 380,812 | 4-6 | 60 | | | |
| EL. 214.0 | 6-7 | 197 | | | |
| | No Refusal | | | | |
| PH-4641 | | | | | |
| N. 1,828,807 | 0-3 | 7 | | | |
| E. 380,987 | 3-5 | 40 | | | |
| EL. 210.5 | 5-6 | 231 | | | |
| | No Refusal | | | | |
| PH-4642 | | | | | |
| N. 1,829,050 | 0-3 | 4 | S1 | 7.6 | SILT & CLAY |
| E. 381,163 | 3-7 | 12 | S2 | 13.6 | Sandy SILT |
| EL. 209.9 | 7-13 | 5 | | | |
| | 13-21 | 30 | | | |
| | 21-22 | 82 | | | |
| | 22-23.2 | 110 | | | |
| | Refusal | | | | |
| PH-4643 | | | | | |
| N. 1,827,847 | 0-8 | 5 | S1 | 7.6 | Sandy SILT & CLAY |
| E. 380,598 | 8-10 | 65 | | | |
| EL. 210.0 | 10-12.7 | 200 | | | |
| | No Refusal | | | | |
| PH-4644 | | | | | |
| N. 1,828,212 | 0-1 | 13 | | | |
| E. 381,195 | 1-3 | 68 | | | |
| EL. 214.6 | Refusal | | | | |
| PH-4645 | | | | | |
| N. 1,828,368 | 0-4 | 5 | | | |
| E. 381,451 | 4-5 | 29 | | | |
| EL. 208.2 | 5-5.9 | 120 | | | |
| | Refusal | | | | |
| PH-4646 | | | | | |
| N. 1,828,525 | 0-2 | 4 | | | |
| E. 381,707 | 2-3 | 20 | | | |
| EL. 205.0 | 3-4 | 79 | | | |
| | 4-4.5 | 156 | | | |
| | Refusal | | | | |
| PH-4647 | | | | | |
| N. 1,827,468 | 0-4 | 4 | S1 | 7.6 | Sandy SILT |
| E. 380,692 | 4-7 | 13 | | | |
| EL. 204.8 | 7-11 | 6 | | | |
| | 11-13.0 | 220 | | | |
| | No Refusal | | | | |
| PH-4648 | | | | | |
| N. 1,827,738 | 0-2 | 4 | | | |
| E. 380,823 | 2-3 | 20 | | | |
| EL. 210.4 | 3-4 | 110 | | | |
| | 4-4.6 | 350 | | | |
| | No Refusal | | | | |
| PH-4649 | | | | | |
| N. 1,827,250 | 0-2 | 3 | | | |
| E. 381,142 | 2-4 | 12 | | | |
| EL. 196.7 | 4-5 | 34 | | | |
| | 5-5.4 | | | | |
| | Refusal | | | | |
| PH-4650 | | | | | |
| N. 1,827,520 | 0-2 | 2 | | | |
| E. 381,273 | 2-3 | 48 | | | |
| EL. 208.9 | 3-3.5 | 120 | | | |
| | Refusal | | | | |
| PH-4651 | | | | | |
| N. 1,827,790 | 0-2 | 3 | | | |
| E. 381,403 | 2-3 | 15 | | | |
| EL. 204.8 | 3-4 | 70 | | | |
| | 4-6 | 212 | | | |
| | No Refusal | | | | |
| PH-4652 | | | | | |
| N. 1,827,141 | 0-12 | 7 | S1 | 7.6 | Sandy SILT |
| E. 381,367 | 12-12.6 | 350 | | | |
| EL. 186.3 | No Refusal | | | | |
| PH-4653 | | | | | |
| N. 1,827,411 | 0-8 | 5 | | | |
| E. 381,498 | 8-10 | 80 | | | |
| EL. 198.8 | 10-10.6 | 340 | | | |
| | No Refusal | | | | |
| PH-4654 | | | | | |
| N. 1,827,681 | 0-4 | 5 | | | |
| E. 381,628 | 4-5 | 116 | | | |
| EL. 201.3 | 5-5.6 | 340 | | | |
| | No Refusal | | | | |
| PH-4655 | | | | | |
| N. 1,826,798 | 0-2 | 4 | S1 | 7.6 | Silty SAND |
| E. 381,479 | 2-4 | 32 | S2 | 13.6 | Silty SAND |
| EL. 178.5 | 4-8 | 12 | | | |
| | 8-12 | 28 | | | |
| | 12-14 | 42 | | | |
| | 14-16 | 130 | | | |
| | 16-18 | 72 | | | |
| | Refusal | | | | |
| PH-4656 | | | | | |
| N. 1,827,057 | 0-8 | 6 | S1 | 7.6 | Sandy SILT |
| E. 381,588 | 8-19 | 45 | S2 | 13.6 | SAND |
| EL. 187.3 | 19-21 | 170 | | | |
| | No Refusal | | | | |
| PH-4657 | | | | | |
| N. 1,827,302 | 0-14 | 6 | S1 | 7.6 | Sandy SILT |
| E. 381,723 | 14-15 | 22 | S2 | 13.6 | Silty CLAY |
| EL. 192.3 | 15-21 | 50 | S3 | 20.6 | Silty SAND |
| | 21-27 | 25 | S4 | 27.6 | SAND |
| | 27-28 | 42 | | | |
| | 28-28.8 | 110 | | | |
| | Refusal | | | | |
| PH-4658 | | | | | |
| N. 1,827,574 | 0-26 | 8 | S1 | 13.6 | Silty CLAY |
| E. 381,855 | 26-29 | 13 | S2 | 27.6 | Silty CLAY |
| EL. 194.9 | 29-36 | 25 | S3 | 33.6 | SAND |
| | 36-36.6 | 100 | | | |
| | Refusal | | | | |
| PH-4659 | | | | | |
| N. 1,826,923 | 0-4 | 8 | | | |
| E. 381,817 | 4-13 | 25 | S1 | 7.6 | Silty SAND |
| EL. 185.7 | 13-16 | 38 | S2 | 13.6 | Silty SAND |
| | 16-17 | 70 | | | |
| | 17-19 | 168 | | | |
| | No Refusal | | | | |
| PH-4660 | | | | | |
| N. 1,827,193 | 0-9 | 11 | S1 | 7.6 | Silty SAND |
| E. 381,948 | 9-15 | 40 | S2 | 13.6 | Clayey SILT & SAND |
| EL. 177.2 | 15-17 | 125 | S3 | 20.6 | SAND |
| | 17-19 | 42 | | | |
| | 19-21.5 | 125 | | | |
| | Refusal | | | | |
| PH-4661 | | | | | |
| N. 1,827,463 | 0-21 | 6 | S1 | 7.6 | Silty CLAY |
| E. 382,078 | 21-24 | 18 | S2 | 13.6 | Silty CLAY |
| EL. 182.1 | 24-26 | 53 | S3 | 20.6 | Sandy, Silty CLAY |
| | 26-27.1 | 320 | S4 | 26.6 | Silty SAND |
| | Refusal | | | | |
| PH-4662 | | | | | |
| N. 1,827,084 | 0-14 | 8 | S1 | 7.6 | Sandy CLAY & SILT |
| E. 382,173 | 14-19 | 28 | S2 | 13.6 | SAND |
| EL. 184.1 | 19-21 | 50 | S3 | 20.6 | SAND |
| | 21-22.7 | 250 | | | |
| | No Refusal | | | | |
| PH-4663 | | | | | |
| N. 1,827,354 | 0-8 | 3 | S1 | 7.6 | Silty CLAY |
| E. 382,303 | 8-14 | 30 | S2 | 13.6 | SAND |
| EL. 181.1 | 14-15 | 170 | | | |
| | Refusal | | | | |
| PH-4664 | | | | | |
| N. 1,826,975 | 0-3 | 5 | S1 | 7.6 | Sandy SILT |
| E. 382,398 | 3-4 | 22 | S2 | 13.6 | SAND |
| EL. 191.7 | 4-11 | 70 | | | |
| | 11-16 | 100 | | | |
| | 16-20 | 60 | | | |
| | 20-22 | 205 | | | |
| | No Refusal | | | | |

File No. BC-A-2/8

# ST. LAWRENCE RIVER

## PROBING RESULTS - CORNWALL CANAL RELOCATION

| Probing No. Coordinates and Surface Elevation | Depth in Feet | Blows per Foot | Samples | | Description of Samples |
|---|---|---|---|---|---|
| | | | No. | Depth | |
| PH-4665 | | | | | |
| N. 1,826,867 | 0-2 | 2 | | | |
| E. 382,623 | 2-5 | 40 | | | |
| EL. 193.4 | 5-7 | 180 | | | |
| | No Refusal | | | | |
| PH-4666 | | | | | |
| N. 1,826,649 | 0-7 | 6 | S1 | 13.6 | Silty SAND |
| E. 383,073 | 7-9 | 14 | S2 | 20.6 | SAND & SILT |
| EL. 192.8 | 9-22 | 35 | | | |
| | 22-23 | 70 | | | |
| | 23-23.4 | 440 | | | |
| | Refusal | | | | |
| PH-4667 | | | | | |
| N. 1,826,431 | 0-8 | 6 | S1 | 14.6 | Clayey SAND & SILT |
| E. 383,523 | 8-13 | 12 | | | |
| EL. 190.3 | 13-17 | 22 | S2 | 20.6 | SILT & SAND |
| | 17-21 | 40 | | | |
| | 21-21.5 | 60 | | | |
| | Refusal | | | | |
| PH-4713 | | | | | |
| N. 1,832,000 | 0-2.0 | | S1 | 5.0 | Sandy SILT & CLAY |
| E. 375,840 | 2.0-9.0 | | | | |
| EL. | Rods pushed by hand to 10.5 | | | | |
| | Refusal | | | | |
| PH-4714 | | | | | |
| N. 1,832,000 | 0-2.0 | | S1 | 5.0 | SILT & CLAY |
| E. 375,960 | 2.0-9.0 | | | | |
| EL. | Rods pushed by hand to 18.0 | | | | |
| | Refusal | | | | |
| PH-4717 | | | | | |
| N. 1,831,401 | 0-19 | 5 | S1 | 7.6 | Soft gray CLAY |
| E. 381,010 | 19-21 | 20 | S2 | 13.6 | Soft gray CLAY |
| EL. 202.1 | 21-22 | 8 | S3 | 20.4 | SAND |
| | 22-24.5 | 30 | | | |
| | Refusal | | | | |
| PH-4718 | | | | | |
| N. 1,831,595 | 0-20 | 4 | S1 | 13.6 | Soft gray CLAY |
| E. 380,841 | 20-22 | 14 | S2 | 20.6 | SAND |
| EL. 206.4 | 22-23.7 | 90 | | | |
| | Refusal | | | | |
| PH-4719 | | | | | |
| N. 1,831,847 | 0-9 | 4 | S1 | 10.4 | SAND |
| E. 380,297 | 9-15 | 30 | | | |
| EL. 207.9 | 15-16 | 72 | | | |
| | 16-18 | 175 | | | |
| | No Refusal | | | | |
| PH-4720 | | | | | |
| N. 1,832,065 | 0-2 | 3 | | | |
| E. 381,130 | 2-0.5 | 65 | | | |
| EL. 210.6 | Refusal | | | | |
| PH-4721 | | | | | |
| N. 1,831,990 | 0-5 | 5 | S1 | 7.6 | Grey CLAY |
| E. 381,325 | 5-16 | 18 | S2 | 13.6 | SAND |
| EL. 205.3 | 16-17 | 95 | | | |
| | Refusal | | | | |
| PH-4722 | | | | | |
| N. 1,831,741 | 0-2 | 3 | S1 | 7.6 | Gray CLAY |
| E. 381,170 | 2-20 | 10 | S2 | 13.6 | Gray CLAY |
| EL 203.9 | 20-23.5 | 18 | S3 | 20.6 | Clayey SAND |
| | Refusal | | | | |
| PH-4723 | | | | | |
| N. 1,831,640 | 0-14.5 | 8 | S1 | 7.6 | Gray CLAY |
| E. 381,340 | Refusal | | S2 | 13.6 | Gray CLAY |
| EL. 203.8 | | | | | |
| PH-4724 | | | | | |
| N. 1,831,890 | 0-7 | 1 | | | |
| E. 381,498 | Refusal | | | | |
| EL. 205.3 | | | | | |
| PH-4725 | | | | | |
| N. 1,831,458 | 0-30 | 5 | S1 | 13.6 | Gray CLAY |
| E. 380,505 | 30-34.3 | 37 | S2 | 27.6 | Gray CLAY |
| EL. 209.7 | Refusal | | | | |
| PH-4726 | | | | | |
| N. 1,831,552 | 0-9 | 5 | S1 | 7.6 | Gray CLAY |
| E. 380,350 | 9-12 | 14 | | | |
| EL. 209.8 | 12-13 | 53 | | | |
| | 13-14 | 112 | | | |
| | No Refusal | | | | |
| PH-4727 | | | | | |
| N. 1,830,982 | 0-2 | 3 | S1 | 7.6 | Brown, clayey SILT |
| E. 381,272 | 2-14 | 10 | S2 | 13.6 | Gray CLAY |
| EL. 209.9 | 14-22 | 25 | S3 | 20.6 | Gray SAND |
| | 22-23 | 62 | | | |
| | 23-25 | 150 | | | |
| | No Refusal | | | | |
| PH-4728 | | | | | |
| N. 1,830,875 | 0-4 | 4 | S1 | 7.6 | Clayey SILT |
| E. 381,442 | 4-9 | 10 | S2 | 13.6 | Sandy SILT |
| EL. 210.5 | 9-16 | 35 | | | |
| | 16-18 | 160 | | | |
| | No Refusal | | | | |
| PH-4729 | | | | | |
| N. 1,830,816 | 0-2 | 2 | | | |
| E. 381,542 | 2-6 | 60 | | | |
| EL. 212.9 | 6-6.5 | 130 | | | |
| | Refusal | | | | |
| PH-4730 | | | | | |
| N. 1,829,145 | 0-2 | 2 | | | |
| E. 382,049 | 2-3 | 28 | | | |
| EL. 201.8 | 3-4 | 118 | | | |
| | No Refusal | | | | |
| PH-4731 | | | | | |
| N. 1,829,010 | 0-9 | 4 | S1 | 7.6 | Gray CLAY |
| E. 382,047 | 9-13.2 | 34 | | | |
| EL. 199.4 | Refusal | | | | |
| PH-4732 | | | | | |
| N. 1,828,900 | 0-20 | 3 | S1 | 7.6 | Silty SAND |
| E. 382,045 | 20-26.4 | 17 | S2 | 13.6 | Gray CLAY |
| EL. 202.9 | Refusal | | S3 | 20.4 | Silty SAND |
| PH-4733 | | | | | |
| N. 1,828,634 | 0-31 | 4 | S1 | 13.6 | Silty CLAY |
| E. 382,041 | 31-33.9 | 22 | S2 | 27.6 | Gray CLAY |
| EL 203.5 | Refusal | | | | |
| PH-4734 | | | | | |
| N. 1,828,330 | 0-2 | 2 | S1 | 13.6 | Silty CLAY |
| E. 382,040 | 2-5 | 12 | | | |
| EL. 203.0 | 5-39 | 5 | S2 | 27.6 | Gray CLAY |
| | 39-44 | 15 | S3 | 40.4 | Silty SAND |
| | 44-46.8 | 65 | | | |
| | Refusal | | | | |
| PH-4735 | | | | | |
| N. 1,828,031 | 0-46 | 7 | S1 | 13.6 | Gray CLAY |
| E. 382,035 | 46-47 | 24 | S2 | 27.6 | Gray CLAY |
| EL. 199.5 | Refusal | | S3 | 40.6 | Gray CLAY |

Sheet 1 of 6
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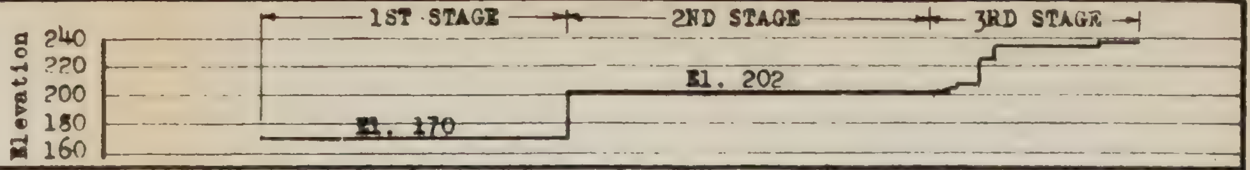
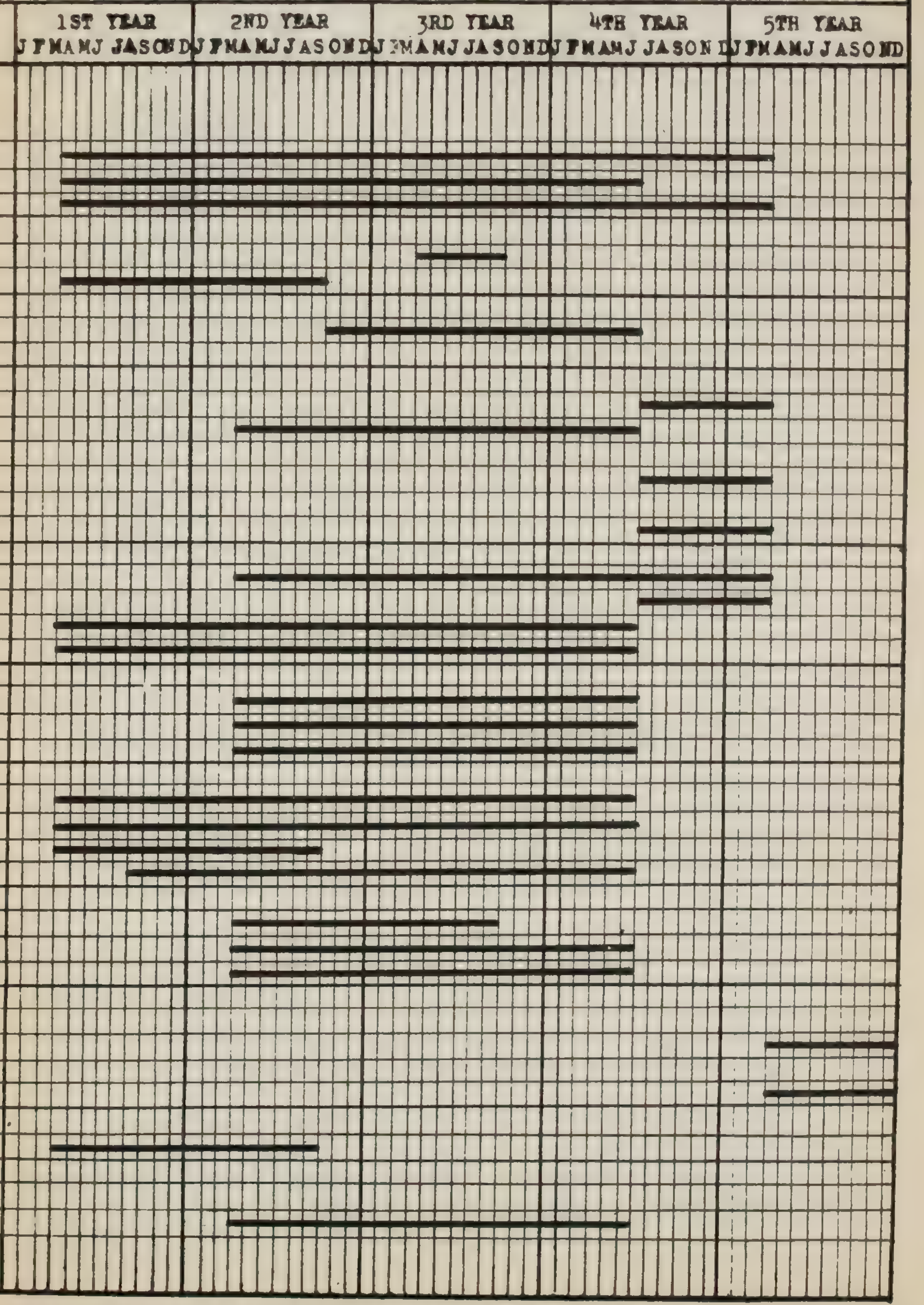
ST. LAWRENCE RIVER PROJECT
CONSTRUCTION PROGRAM



| CONT. NO. | PRIORITY | CONTRACT | ESTIMATED QUANTITY | UNIT |
|---|---|---|---|---|
| | | CANALS, CHANNELS, CUTS & DIKES | | |
| 1 | P-1 | Vicinity of Galop from mile 67 to 74 | | |
| | | Excavation; Dredging | 7,229,000 | c.y. |
| | | " ; Common | 13,255,000 | c.y. |
| | | " ; Rock. | 2,063,000 | c.y. |
| 2 | P-1 | Sparrowhawk Point Cut & Channel | | |
| | | Excavation; Dredging | 1,451,000 | c.y. |
| | | " ; Common | 7,614,000 | c.y. |
| 3 | P-2 | Toussaints Island Cut & Channel | | |
| | | Excavation; Dredging | 254,000 | c.y. |
| 8 | P-2 | Point 3 Points North Cut | | |
| | | Excavation; Dredging | 654,000 | c.y. |
| | | " ; Common | 1,000,000 | c.y. |
| | | Morrisburg Canal Dike Removal | | |
| | | Excavation | 1,145,000 | c.y. |
| | | Canada Island Cut | | |
| | | Excavation | 320,000 | c.y. |
| 10 | P-2 | Point 3 Points South Cut to Canada Island | | |
| | | Excavation; Dredging | 3,578,000 | c.y. |
| | | " ; Rock, Wet | 107,000 | c.y. |
| | | " ; Common | 4,086,000 | c.y. |
| | | " ; Rock, Dry | 100,000 | c.y. |
| 16 | P-2 | Dikes between Waddington & Croil Island | | |
| | | Earth Fill | 535,000 | c.y. |
| | | Riprap | 101,000 | c.y. |
| | | Sand & Gravel | 51,000 | c.y. |
| 20 | P-1 | Long Sault Canal & Dikes | | |
| | | Excavation; Common | 16,150,000 | c.y. |
| | | Earth Fill | 3,274,000 | c.y. |
| | | Stripping; Dike | 207,000 | c.y. |
| | | Riprap | 193,000 | c.y. |
| 32 | P-2 | Dikes & Drainage Ditch - Canada | | |
| | | Excavation; Common | 310,000 | c.y. |
| | | Earth Fill | 5,300,000 | c.y. |
| | | Riprap | 159,000 | c.y. |
| 35 | D | Channel Improvement near Powerhouse | | |
| | | Removal of Crab Island Shoal | | |
| | | Excavation; Dredging | 1,838,000 | c.y. |
| | | Tailrace Cut Outside Cofferdam | | |
| | | Excavation; Dredging | 600,000 | c.y. |
| 36 | P-1 | Cornwall Island North Channel Cut | | |
| | | Excavation; Dredging | 2,056,000 | c.y. |
| 37 | P-1 | Cornwall Island South Channel Cut | | |
| | | Dredging Mouth of Grass River | | |
| | | Excavation; Dredging | 4,841,000 | c.y. |



# CONTRACTS

List of Contracts

Construction Program

Location of Contracts

ST. LAWRENCE RIVER PROJECT
International Rapids Section

LIST OF CONTRACTS

| Cont. No. | Work | Mile | Remarks |
|---|---|---|---|
| 1. | All work in river from mile 67 to 74 | 67-74 | Includes all work in vicinity of Galop Island. |
| 2. | Sparrow hawk Pt.<br>Cut & Channel | 74.6-75.3 | |
| 3. | Toussaints Island<br>Cut & Channel | 75.3-76.2 | |
| 4. | Iroquois Dam and Dike<br>Iroquois Dam<br>Iroquois Dam West Dike<br>Iroquois Dam East Dike<br>Upstream half of Point Rockway Canal | 76.5-79 | Includes all work within Iroquois Dam Cofferdams |
| 5. | Work at Lock 25<br>Raising coping Lock 25<br>North Dike<br>South Dike | 78 | |
| 6. | Iroquois Rehabilitation | 77-78 | |
| 7. | Point Rockway Lock and other work<br>Point Rockway Lock<br>Dikes<br>Downstream half of canal | 79-81 | Includes all work in canal downstream from angle point |
| 8. | Point 3 Points No. Cut<br>Morrisburg Canal Dike Removal<br>Canada Island Cut | 80-85 | |
| 9. | Waddington Rehabilitation | 83-83.3 | |
| 10. | All U.S. work in river from point three points to Canada Island.<br>Point 3 Points South Cut<br>Leishmans Point Cut<br>Ogden Island West Cut<br>Little River Cut<br>Waddington Cut<br>Ogden Island Middle Cut<br>Ogden Island East Cut | 79.5-84.5 | |

| Cont. No. | Work | Mile | Remarks |
|---|---|---|---|
| 11. | Canadian National Railroad Relocation | 76.6-107.0 | |
| 12. | Morrisburg Rehabilitation | 84.6-86.7 | All work in connection with rehabilition of Morrisburg, Ontario. |
| 13. | Highway Relocation<br>Waddington to Massena<br>excluding bridges | 83-99 | |
| 14. | Bridges on highway relocation<br>Waddington to Massena | 84, 85.4, 88 | |
| 15. | Norwood & St. Lawrence R. R.<br>Relocation | 84-85.5 | |
| 16. | Dikes between Waddington and Croil Island<br>Coles Creek Dike<br>Bradford Point Dike<br>Louisville Landing Dikes<br>Nos. 1, 3, 4, and 5 | 89-96 | |
| 17. | Massena Canal Intake<br>Intake works<br>Intake Cut<br>Canal Dike<br>Part of Richards Landing Dike | 98.5-99.5 | Includes all work in connection with the Massena Intake structure. |
| 18. | Raise Lock 21 and construct dikes | 101 | |
| 19. | Iroquois-Cornwall highway relocation | 76.2-108 | |
| 20. | Long Sault Canal and Dikes<br>Main Long Sault Canal<br>Dikes Nos. 1, 5 and 6<br>Part of Dike No. 3<br>Part of Richards Landing Dike<br>Drainage Ditches | 97.0-102.8<br>103.4-106.1 | Includes all work in connection with the Long Sault Canal except the locks and dikes which are connected with locks. |
| 21. | Long Sault Canal Guard Gate and Dike No. 2<br>Guard Gate<br>Dike No. 2 | 101.4 | |

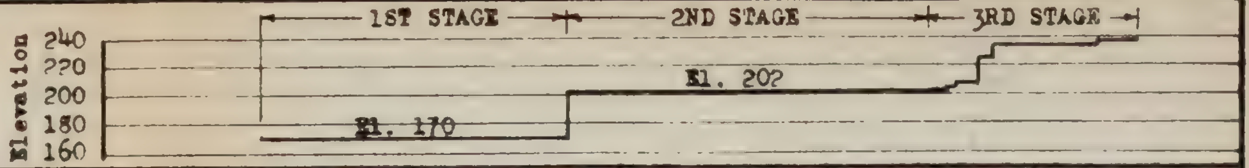
| Cont. No. | Work | Mile | Remarks |
|---|---|---|---|
| 22. | Robinson Bay Lock and attached Dikes<br>Main Robinson Bay Lock Structure<br>Dike No. 4<br>Part of Dike No. 3<br>Part of permanent highway and railroad | 102.8-103.4 | |
| 23. | Grass River Lock attached dikes and approach channel<br>Main Grass River Lock structure<br>Highway improvement:<br>Massena Center to lock<br>Dike No. 7<br>Dike No. 8<br>Downstream Approach Channel<br>Part of NYC RR Relocation<br>Part of Roosevelt Bridge Highway Relocation | 106.1-107.4 | Includes all work in connection with the construction of Grass River Lock and attached dikes including approach channel to deep water in the south channel |
| 24. | Long Sault Dam attached dikes and channel work<br>Main Long Sault Dam<br>South shore dike<br>North shore dike<br>Diversion cut "F" across Long Sault Island<br>Long Sault Island east cut "C"<br>Long Sault Island south cut "G"<br>Part of Permanent highway and railroad | 101-103.5 | Includes all work in connection with Long Sault Dam and shore dikes including all channel work required during construction |
| 25. | Powerhouses<br>Canadian & U. S. substructure and superstructure<br>East & west wing walls<br>Barnhart Island Forebay Dike<br>Part of dike between Powerhouse and Lock<br>Grading U. S. Switchyard<br>Permanent highway & Railroad on Barnhart Island<br>Tailrace excavation within Cofferdam<br>North abutment fill | 103-107 | |

| Cont. No. | Work | Mile | Remarks |
|---|---|---|---|
| 26A | Canadian hydraulic turbine equipment and accessories | 105-107 | |
| 26B | Canadian generator equipment and accessories | | |
| 26C | Canadian high tension transformers and accessories | | Not Part of Project |
| 26D | Canadian Switchboard and switch gear | | |
| 27A | U. S. hydraulic turbine equipment and accessories | 105-107 | |
| 27B | U. S. generator equipment and accessories | | |
| 27C | U. S. high tension transformers and accessories | | Not Part of Project |
| 27D | U. S. Switchboard and switch gear | | |
| 28. | Canadian Switchyard structures & equipment excluding grading | 106.5 | Not Part of Project |
| 29. | U. S. Switchyard structures & equipment excluding grading | 105.3 | Not part of Project |
| 30. | Cornwall Canal Relocation:<br>Canal excavation<br>Canal lock & guard gates<br>Part of Dike to powerhouse<br>Part of New Cornwall Canal Dike<br>Canadian switchyard grading | 105.8-106.8 | |
| 31. | Access to Canadian powerhouse:<br>Access highway & access RR northeast of Lock 19 and to P.H.Sta.3+00<br>Combined highway and RR bridges to Lock 19 | 107-108 | |
| 32. | Dikes and Drainage Ditch-Canadian side.<br>Bergen Lake Dike No. 1<br>Moulinette Dikes Nos. 1 & 2<br>Mille Roches Dikes Nos. 1 & 2<br>Part of New Cornwall Canal Dike<br>New Cornwall Drainage Ditch | 101-107 | |

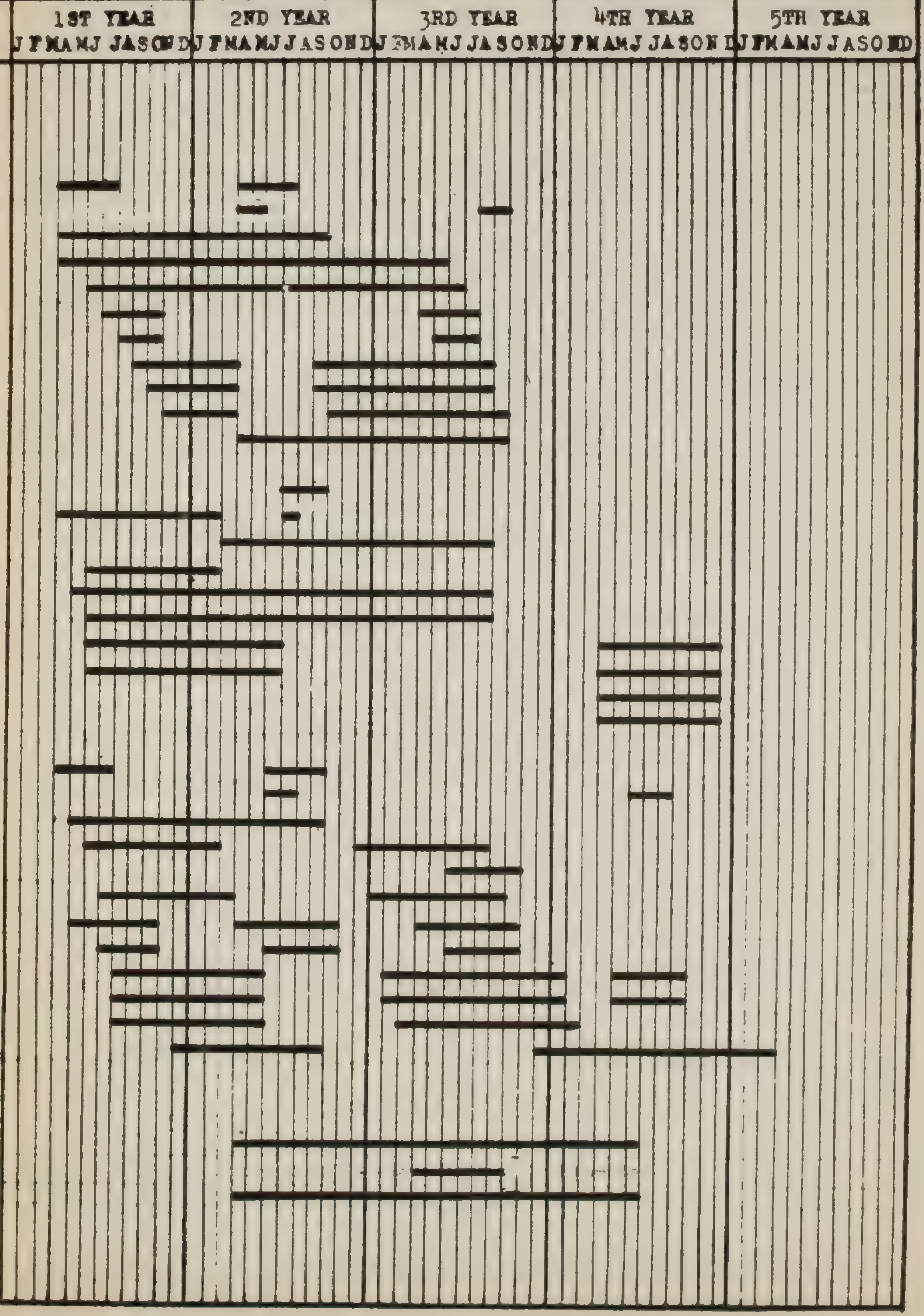
| Cont. No. | Work | Mile | Remarks |
|---|---|---|---|
| 33. | NYC RR Relocation & Roosevelt Bridge highway relocation excluding bridges | 106-108.5 | |
| 34. | Bridges on NYC RR & Roosevelt Bridge highway relocation:<br>Grass River bridge<br>Polly Gut Bridge<br>Removal of Roosevelt Bridge across South Channel | 106-107.5 | Both bridges are combined RR and highway structures. The Grass River Lock Bridge is included in the Grass River Lock contract |
| 35. | Channel Improvement near powerhouse:<br>Removal of Crab Island shoal at Massena Point<br>Tailrace Cut outside cofferdam | 105.5-107 | |
| 36. | Cornwall Island Channel improvement:<br>North Channel Cut | 108-110 | |
| 37. | Cornwall Island Channel improvement:<br>South channel cut<br>Dredging mouth of Grass River | 106.6-113.5 | |
| 38. | Ice Cribs<br>Galop Island ice cribs<br>Groups A, B and C | 69.7-70.7 | |
| 39. | Relocation of transmission line from Cornwall Canal Dike to Robinson Bay Lock including substation and nearby lines in Canada | 103-107 | |
| 40. | Clearing Flowage Basins | | |
| 41. | Construction of Seaway, N. Y. | 102-104 | |

Sheet 2 of 6
4-18-42

ST. LAWRENCE RIVER PROJECT
CONSTRUCTION PROGRAM

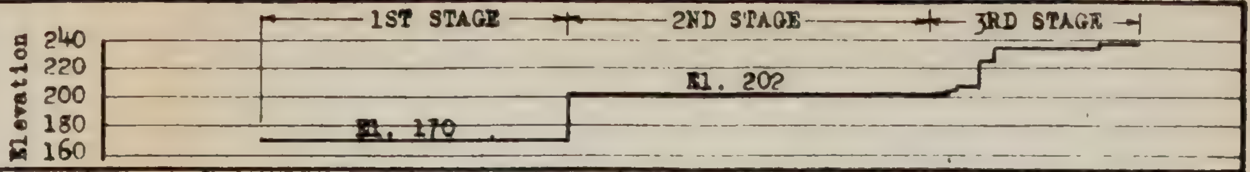


| CONT. NO. | PRIORITY | CONTRACT | ESTIMATED QUANTITY | UNIT |
|---|---|---|---|---|
| | | DAMS AND APPURTENANT STRUCTURES | | |
| 4 | P-1 | Iroquois Dam, Dikes, & part of Rockway Canal | | |
| | | Cofferdams; Construction | Sum | Job |
| | | " ; Removal | Sum | Job |
| | | Excavation; Dredging | 1,012,000 | c.y. |
| | | " ; Common | 2,158,000 | c.y. |
| | | " ; Rock, Dry | 960,000 | c.y. |
| | | Earth Fill; All Classes | 205,000 | c.y. |
| | | Riprap; All Classes | 65,000 | c.y. |
| | | Concrete; All Classes | 244,000 | c.y. |
| | | Installing Steel; Concrete Reinf. | 6,000,000 | lb. |
| | | " " ; Structural | 6,800,000 | lb. |
| | | Installing Spillway Gates | 22,600,000 | lb. |
| 17 | P-1 | Massena Canal Intake Works | | |
| | | Cofferdams; Construction | Sum | Job |
| | | Excavation; Common | 847,000 | c.y. |
| | | " ; Borrow | 666,000 | c.y. |
| | | " ; Rock, Dry | 12,000 | c.y. |
| | | Earth Fill; All Classes | 1,467,000 | c.y. |
| | | Riprap; All Classes | 98,000 | c.y. |
| | | Concrete; All Classes | 92,000 | c.y. |
| | | Installing Steel; Concrete Reinf. | 3,000,000 | lb. |
| | | " " ; Structural | 466,000 | lb. |
| | | Installing Control Gates | 456,000 | lb. |
| 24 | P-1 | Long Sault Dam, Dikes & Channel Work | | |
| | | Cofferdams; Construction | Sum | Job |
| | | " ; Removal | Sum | Job |
| | | Excavation; Diversion Cut | 3,310,000 | c.y. |
| | | " ; Common | 620,000 | c.y. |
| | | " ; Borrow | 180,000 | c.y. |
| | | " ; Rock, Dry | 85,000 | c.y. |
| | | Earth Fill; All Classes | 455,000 | c.y. |
| | | Riprap; All Classes | 35,000 | c.y. |
| | | Concrete; All Classes | 585,000 | c.y. |
| | | Installing Steel; Concrete Reinf. | 5,000,000 | lb. |
| | | " " ; Structural | 7,500,000 | lb. |
| | | Installing Spillway Gates | 14,605,000 | lb. |
| | | VILLAGE REHABILITATION | | |
| 6 | P-2 | Iroquois Rehabilitation | Sum | Job |
| 9 | P-2 | Waddington Rehabilitation | Sum | Job |
| 12 | P-2 | Morrisburg Rehabilitation | Sum | Job |

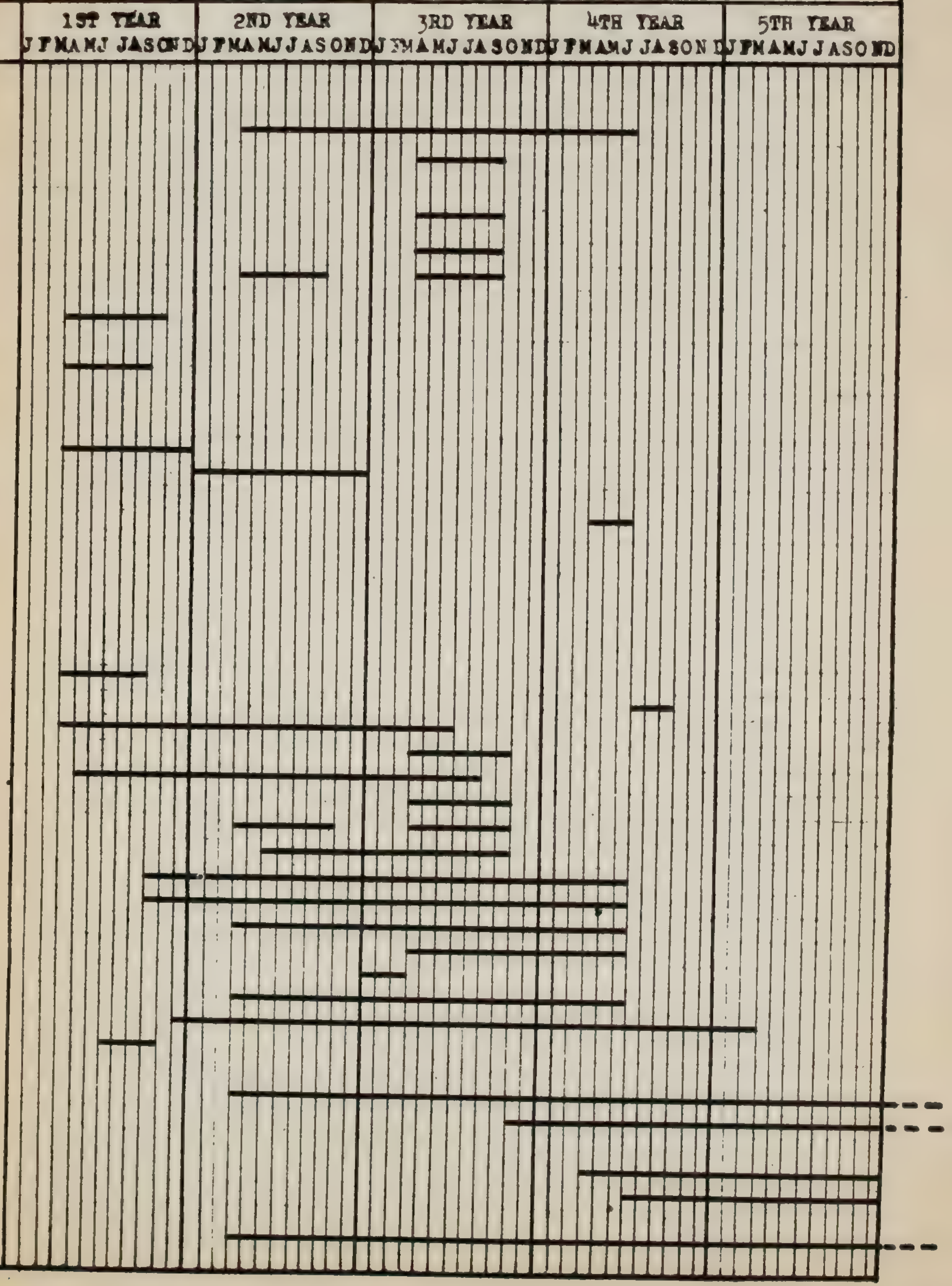


Sheet 3 of 6
4-18-42

ST. LAWRENCE RIVER PROJECT
CONSTRUCTION PROGRAM

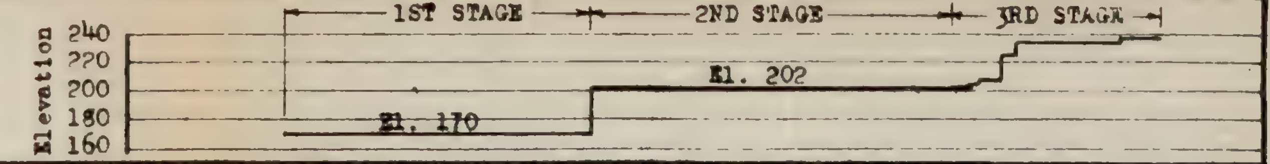


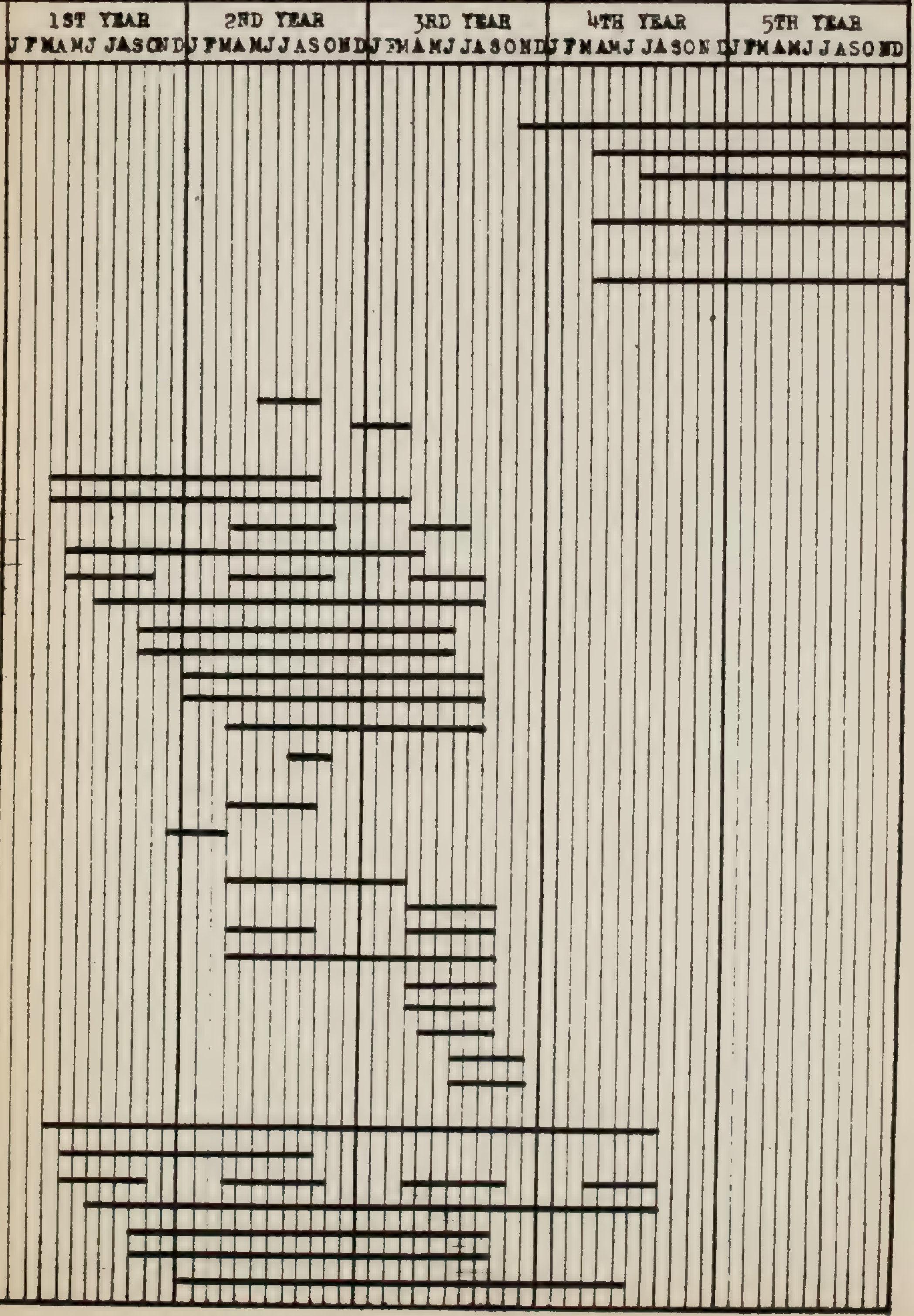
| CONT. NO. | PRIORITY | CONTRACT | ESTIMATED QUANTITY | UNIT |
|---|---|---|---|---|
| | | RAILROAD & HIGHWAY RELOCATION | | |
| 11 | P-2 | Canadian National RR Relocation | 26 | mi. |
| 13 | P-2 | Waddington to Massena Highway Relocation excluding Bridges | 11 | mi. |
| 14 | P-2 | Bridges on Waddington to Massena Highway Relocation | 3 | ea. |
| 15 | P-2 | Norwood & St. Lawrence RR Relocation | 2 | mi. |
| 19 | P-2 | Iroquois-Cornwall Highway Relocation | 32 | mi. |
| 31 | P-0 | Access Highway & RR including Bridges to Canadian Powerhouse | 2 | mi. |
| 33 | P-0 | N.Y.Central RR Reloc. & Roosevelt Bridge Highway Reloc. excluding Bridges | 4 | mi. |
| 34 | P-0 | Bridges on N.Y.Central RR & Roosevelt Bridge Highway Relocation: | | |
| | | Grass River Bridge | Sum | Job |
| | | Pollys Gut Bridge | Sum | Job |
| | | Removal of Roosevelt Bridge across South Channel | Sum | Job |
| | | POWERHOUSES & APPURTENANT STRUCTURES | | |
| 25 | P-1 | Canadian & U. S. Substructure and Superstructure & Forebay Dikes: | | |
| | | Cofferdams; Construction | Sum | Job |
| | | " ; Removal | Sum | Job |
| | | Excavation; Common | 3,821,000 | c.y. |
| | | " ; Borrow | 250,000 | c.y. |
| | | " ; Rock | 225,000 | c.y. |
| | | Embankment; North Forebay Dike | 950,000 | c.y. |
| | | Earth Fill; All Classes | 983,000 | c.y. |
| | | Riprap; All Classes | 316,000 | c.y. |
| | | Concrete; All Classes | 1,918,000 | c.y. |
| | | Installing Steel; Concrete Reinf. | 108,000,000 | lb. |
| | | " " ; Structural | 19,000,000 | lb. |
| | | Installing Gates, Stoplogs & Racks | 33,470,000 | lb. |
| | | Installing Gantry & Overhead Cranes | 3,460,000 | lb. |
| | | Installing Rail | 2,720,000 | lb. |
| | | Misc. Iron & Steel | 2,067,000 | lb. |
| | | Permanent Hwy. & RR - Barnhart Island | 3 | mi. |
| 26A | P-1 | Canadian Hydraulic Turbine Equipment & Accessories | 18 | ea. |
| 26B | P-1 | Canadian Generator Equipment & Accessories | 18 | ea. |
| *26C | P-2 | Canadian High Tension Transformers & Accessories | Sum | Job |
| 26D | P-2 | Canadian Switchboard & Switch Gear | Sum | Job |
| 27A | P-1 | U. S. Hydraulic Turbine Equipment & Accessories | 18 | ea. |



*Not to be included in this project

ST. LAWRENCE RIVER PROJECT
CONSTRUCTION PROGRAM



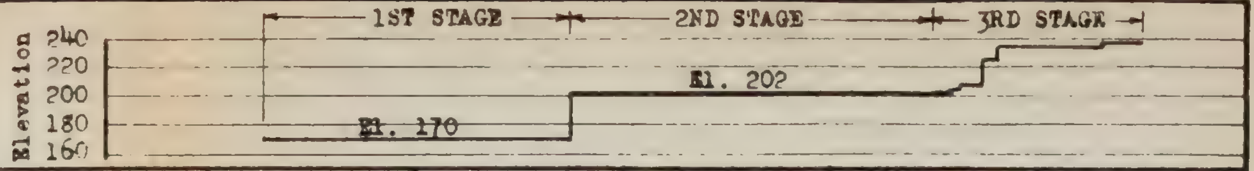


| CONT. NO. | PRIORITY | CONTRACT | ESTIMATED QUANTITY | UNIT |
|---|---|---|---|---|
| | | POWERHOUSES & APPURTENANT STRUCTURES (cont.) | | |
| 27B | P-1 | U. S. Generator Equipment & Accessories | 18 | ea. |
| *27C | P-2 | U. S. High Tension Transformers & " | Sum | Job |
| 27D | P-2 | U. S. Switchboard & Switch Gear | Sum | Job |
| *28 | P-2 | Canadian Switchyard Structures & Equipment excluding Grading | Sum | Job |
| *29 | P-2 | U. S. Switchyard Structures & Equipment excluding Grading | Sum | Job |
| | | LOCKS AND GUARD GATES | | |
| 5 | P-2 | Work at Lock 25 | | |
| | | Earth Fill | | c.y. |
| | | Concrete | | c.y. |
| 7 | P-1 | Point Rockway Lock & Part of Canal | | |
| | | Excavation; Dredging | 2,000,000 | c.y. |
| | | " ; Common | 1,138,000 | c.y. |
| | | " ; Borrow | 450,000 | c.y. |
| | | " ; Rock, Dry | 516,000 | c.y. |
| | | Earth Fill; All Classes | 742,000 | c.y. |
| | | Riprap; All Classes | 49,000 | c.y. |
| | | Concrete; All Classes | 273,000 | c.y. |
| | | Installing Steel; Concrete Reinf. | 600,000 | lb. |
| | | " " ; Structural | 4,205,000 | lb. |
| | | Installing Misc. Castings & Forgings | 393,000 | lb. |
| | | Installing Machinery | 730,000 | lb. |
| | | Installing Swing Bridge & Machinery | Sum | Job |
| 18 | P-2 | Work at Lock 21 | | |
| | | Earth Fill | | c.y. |
| | | Concrete | | c.y. |
| 21 | P-2 | Long Sault Canal Guard Gate and Dike | | |
| | | Excavation; Common | 290,000 | c.y. |
| | | " ; Borrow | 112,000 | c.y. |
| | | Earth Fill; All Classes | 392,000 | c.y. |
| | | Riprap; All Classes | 66,000 | c.y. |
| | | Concrete; All Classes | 131,000 | c.y. |
| | | Installing Steel; Concrete Reinf. | 600,000 | lb. |
| | | " " ; Structural | 2,138,000 | lb. |
| | | Installing Misc. Castings & Forgings | 168,000 | lb. |
| | | Installing Machinery | 348,000 | lb. |
| 22 | P-1 | Robinson Bay Lock & Attached Dikes | | |
| | | Excavation; Common | 3,313,000 | c.y. |
| | | " ; Rock, Dry | 20,000 | c.y. |
| | | Earth Fill; All Classes | 2,586,000 | c.y. |
| | | Riprap; All Classes | 50,000 | c.y. |
| | | Concrete; All Classes | 497,000 | c.y. |
| | | Installing Steel; Concrete Reinf. | 1,100,000 | lb. |
| | | " " ; Structural | 5,490,000 | lb. |

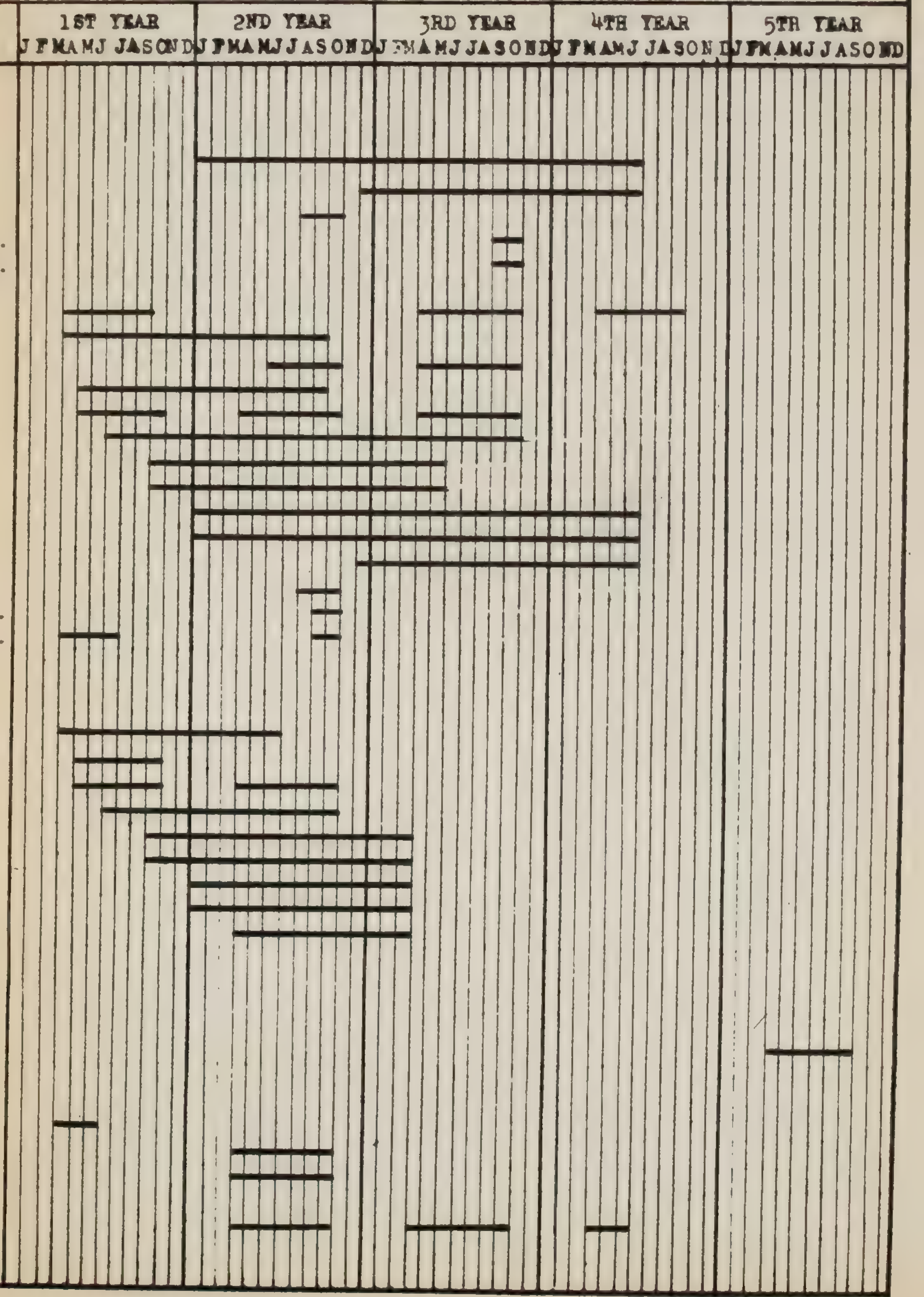
*Not to be included in this project

Sheet 5 of 6
4-18-42

## ST. LAWRENCE RIVER PROJECT
## CONSTRUCTION PROGRAM

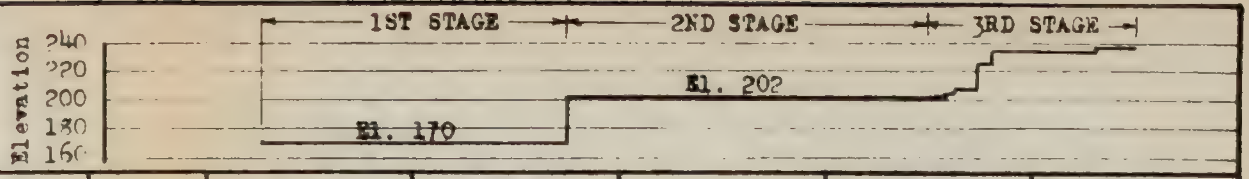


| CONT. NO. | PRIORITY | CONTRACT | ESTIMATED QUANTITY | UNIT |
|---|---|---|---|---|
| | | LOCKS AND GUARD GATES | | |
| 22 | P-1 | Robinson Bay Lock & Attached Dikes(cont.) | | |
| | | Installing Misc. Castings & Forgings | 1,236,000 | lb. |
| | | Installing Machinery | 903,000 | lb. |
| | | Swing Bridge & Machinery | Sum | Job |
| | | Laying Railroad Track | 8,000 | lin.ft. |
| | | Road Surfacing | 19,000 | sq. yd. |
| 23 | P-1 | Grass River Lock, Dikes & Approach Channel | | |
| | | Excavation; Dredging | 6,000,000 | c.y. |
| | | " ; Common | 973,000 | c.y. |
| | | " ; Borrow | 1,000,000 | c.y. |
| | | " ; Rock | 18,000 | c.y. |
| | | Earth Fill; All Classes | 1,702,000 | c.y. |
| | | Riprap; All Classes | 38,000 | c.y. |
| | | Concrete; All Classes | 387,000 | c.y. |
| | | Installing Steel; Concrete Reinf. | 1,600,000 | lb. |
| | | " " ; Structural | 5,547,000 | lb. |
| | | Installing Misc. Castings & Forgings | 1,235,000 | lb. |
| | | Installing Machinery | 904,000 | lb. |
| | | Swing Bridge & Machinery | Sum | Job |
| | | Laying Railroad Track | 5,000 | lin.ft. |
| | | Road Surfacing | 47,000 | sq. yd. |
| 30 | P-1 | Cornwall Canal Relocation including Lock & Guard Gate, Canadian Switchyard Grading & Part of Forebay Dikes | | |
| | | Excavation; Common | 1,352,000 | c.y. |
| | | " ; Rock | 25,000 | c.y. |
| | | Earth Fill; All Classes | 850,000 | c.y. |
| | | Riprap; All Classes | 32,000 | c.y. |
| | | Concrete; All Classes | 383,000 | c.y. |
| | | Installing Steel; Concrete Reinf. | | lb. |
| | | " " ; Structural | | lb. |
| | | Installing Misc. Castings & Forgings | | lb. |
| | | Installing Machinery | | lb. |
| | | MISCELLANEOUS CONTRACTS | | |
| 38 | D | Ice Cribs - Galop Island | | |
| | | Groups A, B & C | Sum | Job |
| 39 | P-2 | Relocation of St.Lawrence River Power Co Transmission Lines | | |
| | | Robinson Bay Area | Sum | Job |
| | | Powerhouse Forebay | Sum | Job |
| | | Line & Substation in Canada | Sum | Job |
| 40 | P-2 | Clearing Flowage Basins | | |
| | | Clearing & Grubbing | Sum | Job |



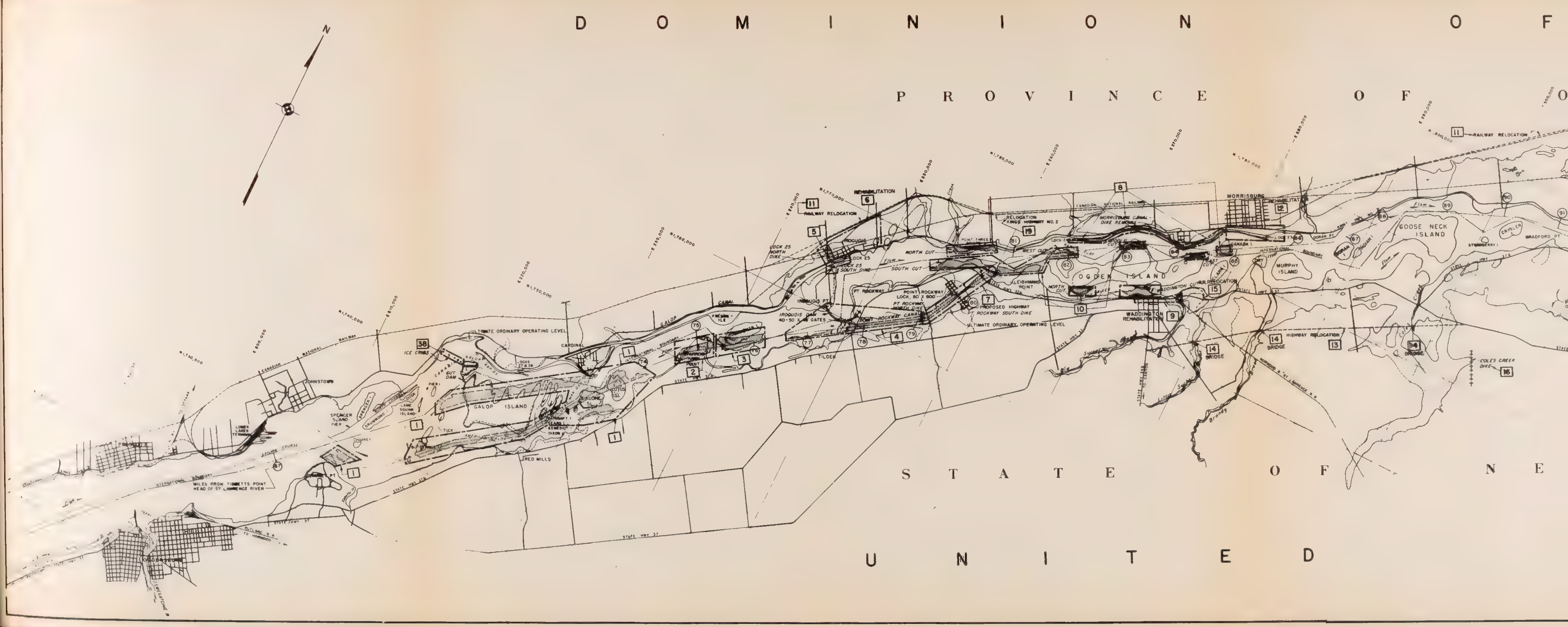
4-18-42

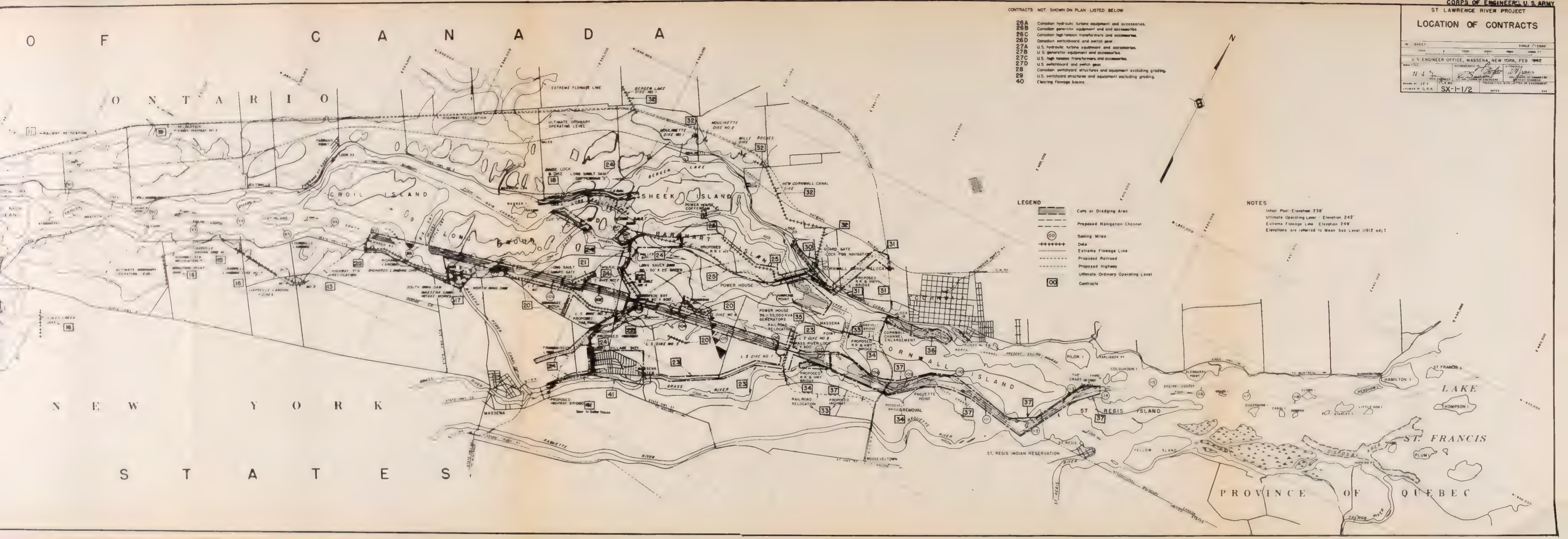
ST. LAWRENCE RIVER PROJECT
CONSTRUCTION PROGRAM



| CONT. NO. | PRIORITY | CONTRACT | ESTIMATED QUANTITY | UNIT | 1ST YEAR J F M A M J J A S O N D | 2ND YEAR J F M A M J J A S O N D | 3RD YEAR J F M A M J J A S O N D | 4TH YEAR J F M A M J J A S O N D | 5TH YEAR J F M A M J J A S O N D |
|---|---|---|---|---|---|---|---|---|---|
| | | **GOVERNMENT CAMP** | | | | | | | |
| 41 | P-0 | Seaway Village | | | | | | | |
| | | Administration Building | Sum | Job | ▬ | | | | |
| | | Central Heating System | Sum | Job | ▬ | | | | |
| | | Other Utilities | | | ▬ | | | | |
| | | Priority Area Work | | | ▬ | | | | |
| | | Non-Priority Work | | | ▬ | | | | |
| | | **SUMMARY OF DREDGING PROGRAM INCLUDED IN THE CONSTRUCTION PROGRAM** | | | | | | | |
| 1 | P-1 | Vicinity of Galop from mile 64 to 67 | 7,815,000 | c.y. | 2,421,000 | 2,309,000 | 1,707,000 | 1,378,000 | |
| 2 | P-1 | Sparrowhawk Point Cut & Channel | 233,000 | c.y. | | | 233,000 | | |
| 3 | P-2 | Toussaints Island Cut & Channel | 723,000 | c.y. | | | 362,000 | 361,000 | |
| 4 | P-1 | Iroquois Dam (part of Rockway Canal) | 1,012,000 | c.y. | 506,000 | 506,000 | | | |
| 7 | P-1 | Point Rockway Lock & part of Canal | 2,000,000 | c.y. | 1,000,000 | 1,000,000 | | | |
| 8 | P-2 | Point 3 Points North Cut | 132,000 | c.y. | | | | 132,000 | |
| | | Morrisburg Canal Dike Removal | 1,169,000 | c.y. | | | | 1,169,000 | |
| | | Canada Island Cut | 399,000 | c.y. | | | | 399,000 | |
| 10 | P-2 | Point 3 Points South Cut to Canada Island | 962,000 | c.y. | | | 481,000 | 481,000 | |
| 23 | P-1 | Grass River Lock and Channel | 6,000,000 | c.y. | 1,880,000 | | 2,060,000 | 2,060,000 | |
| 35 | D | Removal of Crab Island Shoal | 1,838,000 | c.y. | | | | | 1,838,000 |
| | | Tailrace Cut Outside Cofferdam | 600,000 | c.y. | | | | | 600,000 |
| 36 | P-1 | Cornwall Island North Channel Cut | 2,056,000 | c.y. | 1,028,000 | 1,028,000 | | | |
| 37 | P-1 | Cornwall Island South Channel Cut | 4,841,000 | c.y. | | 1,993,000 | 1,993,000 | 855,000 | |
| | | Total Dredging per Year | | | 6,835,000 | 6,836,000 | 6,836,000 | 6,835,000 | 2,438,000 |
| | | Total Dredging | 29,780,000 | | | | | | |

WAR DEPARTMENT





CORPS OF ENGINEERS, U. S. ARMY

ST LAWRENCE RIVER PROJECT

# LOCATION OF CONTRACTS

NO. SHEET — SCALE 1"=2000'

1000 0 2000 4000 6000 8000 FT

U S ENGINEER OFFICE, MASSENA, NEW YORK, FEB 1942

DRAWN BY JEY

CHECKED BY GRK

FILE NO SX-1-1/2

CONTRACTS NOT SHOWN ON PLAN LISTED BELOW

| | |
|---|---|
| 26A | Canadian hydraulic turbine equipment and accessories. |
| 26B | Canadian generator equipment and and accessories |
| 26C | Canadian high tension transformers and accessories. |
| 26D | Canadian switchboard and switch gear |
| 27A | U.S. hydraulic turbine equipment and accessories. |
| 27B | U.S. generator equipment and accessories. |
| 27C | U.S. high tension transformers and accessories. |
| 27D | U.S. switchboard and switch gear. |
| 28 | Canadian switchyard structures and equipment excluding grading. |
| 29 | U.S. switchyard structures and equipment excluding grading. |
| 40 | Clearing flowage basins |

LEGEND

| | |
|---|---|
| ▨ | Cuts or Dredging Area |
| — — — — | Proposed Navigation Channel |
| ⓪⓪ | Sailing Miles |
| ++++++++ | Dike |
| ———— | Extreme Flowage Line |
| -·-·-·-· | Proposed Railroad |
| - - - - - | Proposed Highway |
| | Ultimate Ordinary Operating Level |
| 00 | Contracts |

NOTES

Initial Pool - Elevation 238'

Ultimate Operating Level - Elevation 242'

Extreme Flowage Line Elevation 249'

Elevations are referred to Mean Sea Level (1912 adj.)

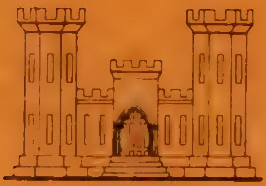
# ST. LAWRENCE RIVER
# PROJECT

# FINAL REPORT

## 1942

DOCUMENTS Room 6

# IROQUOIS DAM
# SPECIFICATIONS



CORPS OF ENGINEERS, U.S. ARMY

U.S. ENGINEER OFFICE • MASSENA, NEW YORK.

APPENDIX III-4 (2)

# ST. LAWRENCE RIVER

# PROJECT

* * * * *

# FINAL REPORT

# 1942

# IROQUOIS DAM

# SPECIFICATIONS

CORPS OF ENGINEERS, U.S. ARMY

U.S. Engineer Office - Massena, New York

July , 1942

APPENDIX III-4 (2)

PART ONE - General Specifications.

PART TWO - Purchase Specifications.

# PART ONE

# IROQUOIS DAM

## GENERAL SPECIFICATIONS

Iroquois Dam Invitation No.___________

No.__________Bidder________________________________________

(Do not write above this line)

# STANDARD GOVERNMENT FORM OF INVITATION FOR BIDS

## (CONSTRUCTION CONTRACT)

WAR DEPARTMENT
UNITED STATES ENGINEER OFFICE
MASSENA, NEW YORK
_______, 1942

1. SEALED BIDS, in duplicate, subject to the conditions contained herein, will be received until 2:00 P.M. E.S.T., ______ and then publicly opened in the United States Engineer Office, Massena, New York, for furnishing all labor, plant, and materials, and performing all work for the construction of Iroquois Dam, on the St. Lawrence River, about 5 miles west of the village of Waddington, New York, all as indicated on the drawings or required by the specifications.

2. SPECIFICATIONS AND PLANS.

(a) The work shall be done in strict accordance with the specifications and drawings which are designated as follows:

(1) Iroquois Dam, specifications.

(2) The drawings which will become a part of this contract are designated in paragraph 1-04 of the specifications.

(b) Where copies of drawings are requested, a deposit of twenty-five dollars ($25.00) will be required to insure their return. The deposit should be in the form of a United States money order or a certified check made payable to "The Treasurer of the United States." The deposit will be refunded upon the return of the plans in good condition within 30 days after date of opening bids.

3. INVESTIGATION OF CONDITIONS. - Bidders are expected to visit the locality and site of the work, and to make their own estimates of the facilities needed, and the difficulties attending the execution of the proposed contract, including local conditions, availability of labor, uncertainty of weather, and other contingencies. In no case will the Government assume any responsibility whatever for any interpretation, deduction, or conclusion drawn from the examination of the site. At the bidder's request, a representative of the Government will point out the site of the proposed operation. Failure to acquaint himself with all available information concerning these conditions will not relieve the successful bidder of assuming all responsibilities for estimating the difficulties and costs of successfully performing and completing the work. (See paragraphs 1-18 and 1-19 of the specifications.)

4. WAGE AND LABOR PROVISIONS. - Wage, labor, and anti-discrimination regulations are specified in paragraph 1-38 of the specifications and Articles 11 (Revised), 17, and 19 (Revised) of the contract. Attention of bidders is invited to War Department labor policy for defense construction projects set out in memorandum of agreement approved July 22, 1941. Successful bidders will be expected to adhere to provisions of the agreement, copies of which are on file at the office of District Engineer, U. S. Engineer Office, Massena, N.Y.

5. DOMESTIC PREFERENCE. - Articles on the preference for domestic articles will be made a part of the contract. (See paragraph 1-35 of the specifications.)

6. ARTICLES ON PATENTS will be made a part of the contract. (See paragraph 1-30 of the specifications.)

7. COMMENCEMENT AND COMPLETION. - The work shall be commenced within 10 calendar days after date of receipt of notice to proceed and shall be completed in accordance with the provisions of paragraph 1-06 of the specifications.

8. EXTENSION OF TIME FOR COMPLETION OF CONSTRUCTION FOR DELAYS DUE TO NATIONAL DEFENSE PRIORITIES will be made. (See paragraph 1-06(c) of the specifications).

9. LIQUIDATED DAMAGES for delay will be prescribed. (See paragraph 1-06 of the specifications).

10. PARTIAL PAYMENTS will be made. (See paragraph 1-08 of the specifications and Article 16 of the contract).

11. ADJUSTMENT OF CONTRACT PRICE by reason of change in Federal, State, and local taxes will be made. (See paragraph 1-42 of the specifications).

12. ADJUSTMENT OF PRICES FOR LABOR AND MATERIALS. Adjustment of prices in accordance with basic increase or decrease of costs of labor and material wil be made as provided in para. 1-46 of the specifications).

13. ESTIMATES OF COST. - Bidders are informed that the Government will prepare estimates of the cost of construction of the work required by the specifications for comparison of bids.

14. REPORTS TO THE DEPARTMENT OF LABOR. - In order to assist the Department of Labor in obtaining employment statistics, bidders, unless otherwise indicated in their bids, will be considered as having voluntarily consented, without cost to the Government, to the inclusion of paragraph 1-39 of the specifications as a part of the contract.

15. BID AND CONTRACT.

(a) Bids must be submitted upon the standard Government form of bid, and the successful bidder will be required to execute the standard Government form of contract for construction (U. S. Standard Form No. 23). Bidders are advised that Article 11 (a) of U. S. Standard Form No. 23 has been revised to permit laborers and mechanics to work more than 8 hours per day, provided overtime compensation at a rate of not less than 1-1/2 times the basic rate of pay is paid for all working time of each laborer or mechanic in excess of 8 hours in any one day. Also Article 19, Nonrebate of U. S. Standard Form No. 23, is revised to read as follows, and the contract to be entered into as a result of this invitation will be altered accordingly:

"ARTICLE 19. Nonrebate. (a) The contractor shall furnish to the Government representative in charge at the site of the work covered by this contract, or if no Government representative is in charge at the site, shall mail to the Federal agency contracting for the work, within 7 days after the regular payment date of each and every weekly pay roll, an affidavit in the form prescrib by regulations issued by the Secretary of Labor and published in the Federal Register of March 1, 1941, 6 F. R. 1211, or any modification thereof pursuant to the act of June 13, 1934, 48 Stat. 948 (U. S. Code title 40, sections 276b and 276c), sworn to by the contractor or the subcontractor concerned or by the authorized officer or employee of the contractor or subcontractor supervising such payment, to the effect that each and every person employed on the work has been paid in full the weekly wages shown on the pay roll covered by the affidavit, that no rebates have been or will be made either directly or indirectly to or on behalf of the contractor or such subcontractor from the full weekly wages earned as set out on such payroll; and that no deductions, other than permissible deductions as defined in the said regulations pursuant to said act of June 13, 1934, and as described in said affidavit, have been or will be made, either directly or indirectly, from the full weekly wages earned as set out on such pay roll.

"(b) The contractor shall comply with all applicable requirements of the said regulations of the Secretary of Labor under the act of June 13, 1934, and the requirements of this article of the contract shall be subject to all applicable provisions of such regulations.

"(c) The contractor shall cause appropriate provisions to be inserted in all subcontracts relating to this work to insure fulfillment of the requirements of this article."

(b) The bid form has an entry for each item on which estimates will be given or payments made, and no other allowance of any kind will be made unless specifically provided for in the specifications or the contract, or adjustments under Article 3 of the contract.

(c) All bids must be for the entire work and must have each blank filled.

(d) The quantities of each item of the bid as finally ascertained at the close of the contract, in the units given, and the unit price of the several items stated by the bidder in the accepted bid, will determine the total payments to accrue under the contract. The unit price bid for each item must allow for all collateral or indirect cost connected with it.

## 16. DATA TO BE SUBMITTED WITH BIDS.

(a) All bids submitted must be accompanied by a statement establishing that the bidder maintains a permanent place of business and has a suitable financial status to meet obligations incident to the work. (See paragraph 3 of the bidding schedule.) In addition, each bidder shall submit with his bid the statement of plant, drawings, charts, and other information and data required below. These data shall be carefully prepared and presented in neat and legible form on tracing paper or tracing cloth so that reproduction may be made therefrom. These data are considered essential in enabling the contracting officer to determine whether the bidder is responsible and experienced in similar types of construction and whether the bid is based on a careful study of construction methods applicable to the work and full realization of the various factors which may affect the progress of the work. Award of this contract shall not be construed as a guarantee by the Government that the materials or supplies listed in the bidding schedule are approved.

(b) Each bidder shall state in the space provided in the bidding schedule a brief description of the character of the work previously executed by him and the locations of the major projects. After the bids are opened, any bidder may be required by the contracting officer to state whether he is now or ever has been engaged on any construction work similar to that proposed, the year in which it was done, and the manner of its execution, and to give such other information as will tend to show his ability to prosecute vigorously the work required by these specifications. (See paragraph 2 of the bidding schedule.)

(c) Drawings shall be submitted indicating the plant layout the bidder proposes to utilize on the work. The drawings shall clearly indicate the location and manner of employment of the various major items of the plant. They shall include the location, construction, and height of each cofferdam, the arrangement of the plant for the handling of materials, and the manner in which excavation and disposal of the excavated materials will be made. They shall also include the location of all material yards and the transportation facilities, as well as the location of the mixing plant and the manner in which concrete will be placed and metalwork erected. The plant lay-out shall be accompanied by a complete list and description inserted in the space provided therefor in the bid form, of all plant that the bidder now has or will have available for commencing and prosecuting this work, and its location at the time of opening bids, in order that it may be inspected by the contracting officer should he so desire. The above information will be considered confidential. When a bidder does not own or possess plant and proposes to procure it, firm options on all major items of proposed plant must be submitted when the bids are opened.

(d) A chart or charts shall be submitted indicating the volume of work to be done and the rate of progress which the bidder agrees to maintain (see paragraph 1-20 of the specifications) for each of the following major operations required in the performance of the work under these specifications:

(1) Cofferdams.
(2) Excavation and Foundation Preparation.
(3) Point Rockway Canal Excavation.
(4) Concrete Masonry.
(5) Embankment.
(6) Gantry Cranes.
(7) Spillway Gates.

Charts shall be in the form of plotted curves in which the abscissae shall represent definite intervals of time measured from date of receipt of notice to proceed with the work, and the ordinates shall represent percentages of completion based on the estimated contract quantities. In preparing the charts, due allowance shall be made for probable delays caused by any unsatisfactory working conditions. Careful consideration shall be given to the preparation of these charts, as the rate of progress proposed by the accepted bid will be made a part of the contract. (See paragraph 1-20 of the specifications.)

## 17. AWARD OF CONTRACT.

(a) Subject to the rights hereinafter reserved, work will be awarded as a whole to the lowest responsible bidder whose proposal fully conforms to the requirements of the specifications and as may be deemed most advantageous to the United States.

(b) A bid may be rejected if the bidder fails to furnish bid bond or to submit the data required with his bid or cannot show that he has the necessary capital and experience and owns, controls, or can procure the necessary plant to commence the work at the time prescribed in the specifications and thereafter to prosecute and complete the work at the rate or time specified; and that he is not already obligated for the performance of other work which would delay the commencement, prosecution, or completion of the work contemplated in this advertisement.

(c) Any unbalanced bid which, in the opinion of the contracting officer jeopardizes the interest of the United States will be subject to rejection for that reason.

(d) The right is reserved, as the interest of the Government may require, to reject any and all bids and to waive any informality in bids received.

(e) Bidders shall indicate whether they intend to use natural sand or crushed stone sand in concrete by placing their unit price bid in the space provided for concrete in the Schedule of Bid Items, opposite the one they intend to use, and shall cross out the other. In awarding the contract, the bidders who specify using crushed stone sand will have their unit bid price for all classes of concrete increased 11 cents for the purpose of comparing bids only. This increase is due to the necessity of adding extra cement furnished by the Government.

18. GUARANTY. - Guaranty will be required with each bid as follows: Bid Bond, Standard Form No. 24, will be executed in a penal sum not less than 10 percent of the total amount of the bid but not exceeding $2,500,000. Individual sureties will justify in sums aggregating not less than double the penalty of the bid bond. (See paragraphs 8 and 9 of the Instructions to Bidders.)

19. PERFORMANCE AND PAYMENT BONDS will be required as follows:

(a) A performance bond with good and sufficient surety or sureties, for the protection of the United States, Standard Form No. 25, will be executed in a penal sum not less than ten percent (10%) of the full amount of the consideration of the contract, but not exceeding $2,500,000.

(b) If the consideration of the contract will exceed $2,000 in amount, a payment bond with good and sufficient surety or sureties, for the protection of persons furnishing material and labor for the work, Standard Form No. 25-A, will be executed in a penal sum of one-half of the full amount of the consideration of the contract when the latter is not more than one million dollars ($1,000,000); forty percent (40%) where the contract exceeds one million dollars ($1,000,000) but is not more than five million dollars ($5,000,000); and two million five hundred thousand dollars ($2,500,000) for all contracts above five million dollars ($5,000,000).

20. PROVISIONS OF THE ASSIGNMENT OF CLAIMS ACT of October 9, 1940, (Public No. 811-76th Congress) will be made a part of the contract. (See paragraph 1-45 of the specifications.)

21. ADDRESS FOR BIDS. - Envelopes containing bids must be sealed, marked, and addressed as follows:

Mark in upper
left hand corner:

Bid for Construction of
Iroquois Dam

Invitation No. ________

To be opened at 2:00 P.M., E.S.T.

______________________________

Address:

To: The District Engineer
U. S. Engineer Office
Massena, New York

Note: See Standard Government Instructions to Bidders and copy of the Standard Government Form of Contract, Bid Bond, Payment Bond, and Performance Bond, which may be obtained upon application.

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WAR DEPARTMENT
U. S. Engineer Office
St. Lawrence River District
Massena, N. Y.

Specifications: Iroquois Dam

Appropriation:

## SECTION I - GENERAL PROVISIONS

1-01. LOCATION. - The site of the work is located near the head of the International Rapids Section of the St. Lawrence River, about 5 miles west of the village of Waddington in St. Lawrence County, New York, and directly south of the Canadian town of Iroquois, Ontario. The site may be reached by U.S. Highway 37 on the American side of the River and by Highway No. 2 on the Canadian side. For transportation facilities see paragraph 1-19.

1-02. WORK TO BE DONE.

(a) The work provided herein is authorized by ________________ Act, approved __________________________, 1942.

(b) The work to be done under this contract and in accordance with these specifications consists of furnishing all plant, superintendence, labor and materials, except as noted in paragraph 1-10, and performing all work required for the construction of the Iroquois Dam, except for specifically excepted items, with appurtenant works, complete in accordance with the drawings and these specifications. The main features of the work are as follows:

(1) Excavation for and construction of cofferdams for the concrete dam sections, including maintenance, unwatering, and removal, (See Section II).

(2) Excavation for foundations of concrete structures including foundation preparation and grouting, and excavation of core trench and stripping foundation for earth fill. (See Section III).

(3) Construction of rolled earth fill wing dams and embankment complete, including placing and compacting earth, placing protective riprap, and seeding. (See Section IV).

(4) Construction of the concrete dam including placing concrete, reinforcement, and embedded parts for the spillway, bulkheads, guard houses, and appurtenant works all as shown on the plans and described in these specifications.

(5) Erection and installation of 32 double-leaf and 8 single-leaf fixed wheel, vertical lift gates, including lifting and latching mechanisms, plus one double-leaf emergency gate and miscellaneous mechanical gate equipment including gate storage and repair pit. Gates to be split into two sections each 24 feet high. (See Section VII).

(6) Erection and installation of two gantry cranes under the supervision of an erection engineer furnished and paid for by the crane manufacturer. (See Section VII).

(7) Provision by the contractor of terminal facilities for delivery of material and construction of access roads to the site. No payment will be made for terminal facilities or access roads.

(8) All arrangements for bringing electric power to the site including the construction of the necessary transmission line and substation.

No payment will be made to the contractor for this work.

(9) The excavation of a section of the Point Rockway Navigation Canal between stations 32 + 00 and 159 + 50 as shown on sheet No. 30 according to the plans and specifications for the construction of that canal.

(10) Miscellaneous items including electrical conduit system, maintenance and repair bay, Government field office, and other work as specifie or shown on the drawings; and such indidental work as may be needed or ordered in writing by the contracting officer.

## 1-03. DESCRIPTION.

(a) Iroquois Dam will be a concrete gravity structure consisting of bulkhead sections 193 feet long at each end, with a spillway section 2,390 feet long between, which includes 40 gate openings 50 feet wide and 39 piers 10 feet wide, making a total length for the concrete dam of 2,776 feet. The average height of the dam will be approximately 95 feet measured from the rock foundation. The concrete bulkhead at the west or canadian end will contain an electrical bay, and that at the east of United States end will contain an electrical bay, gate storage bay, and gate repair bay. The bottom of the spillway opening is a low sill at elevation 200.0. Double leaf spillway gates will be 48 feet high split into two 24 foot sections. Single leaf gates will be 24 feet high and will rest on concrete stoplogs. The gates will be the fixed-wheel vertical-lift type and will be operated by two travelling gantry cranes. The wind dams extending approximately 600 feet from the east end and 200 feet from the west end of the adjacent bulkhead sections will be of rolled earth protected by riprap as shown on the drawings.

(b) Point Rockway Canal will have an overall length of approximately 2 miles and a bottom width of 442 feet. The depths of excavation will vary from 0 to approximately 30 feet.

## 1-04. MAPS AND DRAWINGS.

(a) The work shall conform to maps and drawings marked "St. Lawrence River Project, Iroquois Dam," titled and file marked as listed below, which form a part of these specifications and which are filed in the U. S. Engineer Office, St. Lawrence River District, Massena, New York.

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| 43 | Cross Sections | 190/14 |

(b) These drawings show the work with as much detail as is possible in the present stage of development of the design. The work shall conform also to such other drawings and addenda relating thereto as may be published and/or exhibited in the office of the contracting officer prior to the opening of proposals, and to such drawings in explanation of details as may be required from time to time during construction, including such modifications as the contracting officer may consider necessary on account of conditions that are found to exist during the prosecution of the work. Detail bar lists and bending schedules for steel reinforcement will be furnished by the United States.

(c) Prior to the execution of the work the contractor shall check all drawings and shall immediately report to the contracting officer any errors or omissions discovered therein. Errors and/or omissions in drawings will not relieve the contractor of his responsibility for the correct fitting together and exact position of all parts of the work in accordance with the specifications. Parts and details not fully indicated on the drawings shall be detailed by the contractor in accordance with the best practice, or as directed by the contracting officer.

(d) The contractor shall submit fabricator's shop drawings of all structural steel and other metal work for approval. He shall also submit such shop drawings and material lists of all mechanical and electrical equipment as may be required by the contracting officer. No material shall be furnished or work done thereon prior to approval of these drawings. The contractor shall submit three (3) prints of each of such detailed drawings to the contracting officer who will return one print with his approval or notations of such changes as he finds necessary. Each print submitted for approval shall have in the lower right-hand corner just above the title a white space 3 inches by 4 inches in size in which the contracting officer will indicate the action taken. After approval, the contractor shall furnish the contracting officer one tracing and five prints of each approved drawing. Three copies or sets of parts catalogs, spare parts lists and operating instructions shall be furnished as specified above or as requested by the contracting officer. Payment for the contractor's drawings, including revisions thereof, parts catalogs, spare parts lists and operating instructions shall be included in the contract prices paid for material or work. All of these items will form a part of the contract when approved by the contracting officer.

(e) Ten sets of prints of necessary contract drawings (one-half size reproductions, or full size if desired) and twenty sets of specifications will be furnished the contractor without charge. Additional prints may be secured upon request at the cost of reproduction.

1-05. QUANTITIES. - The following estimate of quantities of work to be performed, as also shown in the "Schedule of Bid Items" under these specifications, is given only to serve as a basis for canvassing bids and for determining the approximate amount of the consideration of the contract. Unless the contract is terminated by the failure of Congress to appropriate additional funds (See paragraph 1-08), the contractor will be required to complete the work specified in paragraph 1-02 hereof, be the required quantities more or less than the amounts shown.

| Item No. | Designation | Unit | Quantity |
|---|---|---|---|
| 1 | Excavation; Cofferdam | Cu.Yd. | 107,400 |
| 2 | Timber Cribs in Place | M.B.M. | 6,800 |
| 3 | Crib Sheathing (Bulkheads) | Sq.Ft. | 16,000 |
| 4 | Steel Sheet Piling In Place | Sq.Ft. | 64,300 |
| 5 | Crib Fill | Cu.Yd. | 155,000 |
| 6 | Earth Fill; Cofferdams | Cu.Yd. | 298,500 |
| 7 | Rock Fill; Cofferdams | Cu.Yd. | 106,700 |
| 8 | Riprap; Cofferdams | Cu.Yd. | 20,800 |
| 9 | Derrick Stone; Cofferdams | Ton | 5,000 |
| 10 | Cofferdam Removal | Cu.Yd. | 569,000 |
| 11 | Unwatering Cofferdams | Acre Ft. | 25,000 |
| 12 | Excavation; Common, Dam | Cu.Yd. | 657,200 |
| 13 | Excavation; Rock, Dam | Cu.Yd. | 32,000 |
| 14 | Excavation; Borrow | Cu.Yd. | 100,000 |
| 15 | Excavation; Common, Canal | Cu.Yd. | 2,412,000 |
| 16 | Excavation; Rock, Canal | Cu.Yd. | 928,000 |
| 17 | Line Drilling | Sq.Ft. | 45,000 |

| Item No. | Designation | Unit | Quantity |
|---|---|---|---|
| 18 | Drilling 3 inch Exploratory Holes | Lin Ft. | 15,000 |
| 19 | Drilling 6 inch Concrete Cores | Lin Ft. | 1,000 |
| 20 | Drilling Foundation Grout Holes in Rock | Lin Ft. | 10,000 |
| 21 | Drilling Foundation Grout Holes in Concrete | Lin Ft. | 2,000 |
| 22 | Core Boxes | Each | 200 |
| 23 | Providing Pressure Grouting Equipment | Sum | Job |
| 24 | Pressure Grouting | Cu. Ft. | 10,000 |
| 25 | Rock Flour in Grout | Cu. Ft. | 1,500 |
| 26 | Sand in Grout | Cu. Ft. | 1,500 |
| 27 | Earth Fill; Compacted | Cu. Yd. | 205,000 |
| 28 | Additional Compaction | square (100sf) | 50,000 |
| 29 | Sand and Gravel Becking | Cu. Yd. | 6,500 |
| 30 | Riprap, Dumped; Class A | Cu. Yd. | 6,500 |
| 31 | Riprap, Dumped; Class B | Cu. Yd. | 8,900 |
| 32 | Rock Fill; Random | Cu. Yd. | 50,000 |
| 33 | Rolled Gravel Surface | Sq. Yd. | 23,000 |
| 34 | Seeded Topsoil | Acre | 2 |
| 35 | Seeding | Acre | 2 |
| 36 | Concrete; Class A (Natural Sand Crushed Stone Sand) | Cu. Yd. | 3,500 |
| 37 | Concrete; Class B (Natural Sand Crushed Stone Sand) | Cu. Yd. | 61,000 |
| 38 | Concrete; Class C (Natural Sand Crushed Stone Sand) | Cu. Yd. | 179,000 |
| 39 | Concrete Stoplogs | Sum | Job |
| 40 | Special Bituminous Filler; Type C | Cu. Ft. | 170 |
| 41 | Steel Erection; Concrete Reinforcing | Lbs. | 6,000,000 |

| Item No. | Designation | Unit | Quantity |
|---|---|---|---|
| 42 | Steel Erection; Structural | Lbs. | 6,800,000 |
| 43 | Steel Rails; Placing | Lbs. | 381,000 |
| 44 | Spillway Gate; Erection | Lbs. | 22,600,000 |
| 45 | Gantry Cranes; Erection | Sum | Job |
| 46 | Steel Forgings; Miscellaneous | Lbs. | 2,500 |
| 47 | Steel; Structural, Miscellaneous | Lbs. | 5,000 |
| 48 | Iron; Cast | Lbs. | 20,000 |
| 49 | Pipe; Cast Iron | Lbs. | 39,000 |
| 50 | Pipe; Wrought Iron | Lbs. | 2,000. |
| 51 | Pipe; Black Steel | Lbs. | 2,000 |
| 52 | Pipe; Concrete, Halves | Lin Ft. | 360 |
| 53 | Bronze Castings | Lbs. | 2,700 |
| 54 | Copper; Sheet | Lbs. | 500 |
| 55 | Corrugated Iron; Water Stop | Lbs. | 4,800 |
| 56 | Doors; Steel | Lbs. | 700 |
| 57 | Windows; Steel | Lbs. | 3,600 |
| 58 | Highway Guard Rail | Lin Ft. | 2,600 |
| 59 | Bridge Guard Rail | Lin Ft. | 2,600 |
| 60 | Handrailing; Steel Pipe 2" | Lin Ft. | 9,200 |
| 61 | Handrailing; Steel Pipe 1½" | Lin Ft. | 300 |
| 62 | Safety Treads | Lbs. | 1,200 |
| 63 | Roof Drains | Each | 2 |
| 64 | Roof Surfacing | Square (100sf) | 4 |
| 65 | Flagpoles | Each | 2 |
| 66 | Conduit; Metal | Lbs. | 12,000 |
| 67 | Electric Grounding System | Sum | Job |
| 68 | Field Office | Sum | Job |
| 69 | Field Office Extension | Sum | Job |

### 1-06. COMMENCEMENT, PROSECUTION AND COMPLETION.

(a) The contractor will be required to commence work under the contract within ten (10) calendar days after the date of receipt by him of notice to proceed, to prosecute the said work with faithfulness and energy, and to complete the entire work within 750 calendar days after said date of receipt by him of notice to proceed, plus any extensions of time duly granted under the provisions of the contract and specifications. The work shall be prosecuted as vigorously as practicable during all seasons of the year.

(b)(1) In case of failure on the part of the contractor to complete the entire work within the time thus determined and agreed upon for its completi the contractor shall pay to the Government as liquidated damages the sum of $300 for each calendar day of delay until construction is completed and the dam is placed in operating condition as determined by the contracting officer.

(2) Should the construction be completed and placed in operating condition except for minor finishing work as determined by the contracting offic the contracting officer may conditionally accept and occupy the work; and thereafter the contractor shall pay to the Government, as liquidated damages the sum of $25.00 for each calendar day of delay until all the items and minor finishing work have been completed and accepted.

(3) In the event the entire structure has been completed and accepted and all work under the contract has been completed except for removal of contractor's plant and buildings and restoration of the site, no further liquidated damages will be assessed, but final payment will not be made until th latter work has been accomplished as required.

(c) If the completion of the undertaking to be performed under the terms of this contract be delayed by reason of delay in the delivery of material or supplies essential to such performance because of national defense priorities and without the fault or negligence of the contractor, the time of performance will be extended for a period equal to such delay, as determined by the contracting officer, and subject to appeal, as provided in Article 9 of the contract.

1-07. SUNDAYS, HOLIDAYS, AND NIGHTS. - Work on Sundays, holidays, and nights will be at the option of the contractor. However, when the contractor elects to work at such times notice of his intention to do so shall be given the contracting officer within a reasonable time in advance thereof

### 1-08. PAYMENTS.

(a) (Availability of Funds?)

(b) Payments will be made monthly on estimates of work performed in accordance with the contract and not included in any prior estimate, except that ten percent (10%) of the amount of each estimate will be retained until the total amount retained is ________________ dollars (________________), and this amount will be retained until it equals ten percent (10%) of the remaining work to be done. Thereafter with each monthly payment there will be paid such portion of the amount so retained as is in excess of ten percent (10%) of the work remaining to be done until the amount retained is reduced to ________________ dollars (________________), which amount will be retained until the completion of the contract when final payment will be made.

### 1-09. WORK COVERED BY CONTRACT PRICE.

(a) The contractor shall, under his contract prices, furnish and pay for all materials (except as specified in paragraph 1-10), labor and equipment for all permanent, temporary, preparatory and incidental work, furnish all accessories and do everthing which may be necessary to carry out the contract in good faith, which contemplates everything completed in good working order, of good material and with accurate workmanship, skillfully fitted and properly connected and put together.

## 1-10. MATERIALS FURNISHED BY THE UNITED STATES.

(a) The following material furnished by the United States will be delivered to the contractor f.o.b., at his terminal, in the vicinity of the damsite.

(1) Cement
(2) Reinforcement
(3) Spillway Gates, Gantry Cranes, and Appurtenances
(4) Structural Steel
(5) Rails for Gantry Crane
(6) Cofferdam Timber and Drift Pins, Bolts, Washers, and Tie Rods for same.

The Government will at all times expedite the delivery of all orders but the Government will not be liable for any expense or delay caused the contractor by delayed deliveries except as provided for under Article 9 of the contract. The contractor shall be responsible that all railroad cars are unloaded promptly and will be held liable for any demurrage charges due to his failure to do so. He will be required to unload, deliver to site, store, clean, assemble, install, and paint this equipment and materials in accordance with these specifications, and the contract drawings.

(b) All materials and equipment shall be adequately housed or otherwise protected against deterioration and damage. When material stored at the site is not adequately protected by the contractor, such material will be kept protected by the contracting officer at the expense of the contractor. Any materials furnished by the Government, which are damaged or broken by the contractor during the unloading, storing, or transporting of such materials, or in the prosecution of the work, shall be replaced by the contractor at his expense.

(c) The contractor shall check the quantity and condition of all materials delivered to him at the time of unloading, and in case there is damage to, or shortage of materials, he shall report it to the contracting officer in writing within 24 hours after delivery. If there is any shortage, or damage which in the opinion of the contracting officer is sufficient to cause the materials to be unfit for use in the work, and the shortage or damage has not been reported as specified above, the contractor will be charged with the actual cost of replacement of such shortage or damage.

(d) Cement for Concrete. - The Government will furnish f.o.b. at the contractor's terminal all cement required for the work covered by these specifications. All cement furnished, except high early strength, will be a moderate-heat-of-hardening Portland cement.

(e) Cement will be made available to the contractor at his terminal at any time after the date of notice to proceed, but he shall give the Government at least 30 days notice in advance of the time he will require the first material, and thereafter he shall at all times keep the contracting officer informed of his anticipated requirements. Ten days before the first of each month or at such other times as may be directed by the contracting officer, the contractor shall furnish written notice of his future cement requirements for the next 30 days. Copies of all orders for cement will be furnished promptly to the contractor. The cement will be furnished in bulk except that necessary for grouting and finishing work, which will be furnished in paper bags. Any cement, bulk or bag, which shall be damaged after delivery to the contractor shall be paid for by him. Any difference in excess of one-half of one percent between the net quantity of bulk cement delivered to the contractor, and the quantity incorporated in the completed and accepted work will be charged to the contractor, at its cost to the Government at the point of delivery to the contractor. The quantity of bulk cement delivered to the contractor will be determined by certified shipping weights. The contractor shall provide at the site, a minimum storage for 8,000 barrels of bulk cement and 300 barrels of bag cement. In order that cement will not become unduly aged after delivery the contractor shall not use cement in the work directly from the freighting o transporting operations whenever any cement is available that has been store more than 60 days after delivery to the contractor. Cement that has been store for more than 90 days shall be retested at the expense of the contractor. (See paragraph 1-31 (d).) Storage bins for cement shall be so constructed that there will be no dead storage and will provide adequate protection against the elements.

(f) Cement furnished by the Government may be used by the contracto in erecting construction plants and facilities. The contractor will be billed for the actual cost to the Government at the point of delivery for furnishing the materials so used by the contractor. The materials thus used shall not be included in the one-half of one percent tolerance specified above.

(g) The contractor shall be responsible for the transportation of al cement furnished by the Government from the contractor's terminal to the site of the construction. The cost of such transporting and unloading shall be included in the contract unit prices for those items on which the cement will be used.

(h) The contractor shall return to the Government, f.o.b. in cars at his terminal, all cement furnished by the Government and not used. The contractor will be charged for any cement, not used and not returned, except for ½ of 1% allowed for loss, and amount equal to the cost to the Government at the point of delivery to the contractor.

(i) Reinforcement. - Steel reinforcement for concrete will be furnis ed the contractor f.o.b. freight cars in the contractor's terminal. Reinforcement will be cut to length and bent before delivery. See paragraph 5-17, for specified placing requirements.

(j) Reinforcement will be made available to the contractor within 150 days after the contractor notifies the Government he will require such reinforcement, and he shall furnish written notice of his requirements for the first four months. Thereafter he shall at all times keep the contracting offic informed of his anticipated requirements for reinforcement in the following manner: On the first day of the first 4-month period the contractor shall furn written notice of his future requirements during the second 4-month period, and so on through the duration of the contract. Upon receiving notice to proceed the contractor shall also furnish the contracting officer a general schedule of reinforcement requirements for the duration of the contract by four-month periods, it being understood that shipments may be based on definite requirements as stated in the contractor's regular periodic notices of requirements.

(k) Copies of all orders for concrete reinforcement will be furnished promptly to the contractor. Any reinforcement which shall be damaged after delivery to the contractor, and any difference in excess of one-half of one percent between the net quantity of reinforcement delivered to the contractor and the quantity incorporated in the completed and accepted work will be charge to the contractor, at its cost to the Government at the point of delivery to the contractor. The quantity of reinforcement delivered to the contractor will be determined by certified shipping weights.

(l) Spillway gates, structural steel girders, gantry cranes, rails, and appurtenances (see Sections VII and VIII) will be made available at the contractor's terminal for erection by the contractor. The contractor shall furnish written notice and schedule of his requirements for the spillway gates, structural steel, gantry cranes, rails, and appurtenances, at least 150 days before the time proposed for starting erection.

### 1-11. ELECTRICAL ENERGY AND EQUIPMENT TO BE FURNISHED BY THE CONTRACTOR.

(a) The contractor shall make arrangements and provide, without cost to the United States, all facilities and equipment necessary to furnish himself with electrical energy for power and lighting. This shall include bringing power from existing lines in the vicinity to the site, and the provision of transformers, poles, wire, switches, lights, and any other equipment that may be necessary. The contractor will be required to light, without cost to the Government during the construction period all job roads constructed primarily for his contract, compartments within the bulkheads, outside work areas, all safety lights, range lights (See paragraph 1-22) and any other lighting as directed all to the satisfaction of the contracting officer. Energy shall be 3-phase, 60-cycle for the operation of all permanent Government equipment and shall be furnished at the voltage as required for each specific use or as indicated on the drawings. The contractor shall maintain service until completion of the contract. All costs for furnishing electrical energy, equipment, installation, maintenance, and the removal of all temporary apparatus shall be borne by the contractor.

(b) The contractor shall furnish to the Government for the period of this contract the electrical energy for lighting and miscellaneous uses in the government field office (Section XI). The contractor shall provide an electric meter in the field office, and will be paid by the Government each month for electrical energy furnished the field office at the rate of the actual cost to him for electrical energy. The energy required in the field office shall be 220/110-volt, 60-cycle, single-phase, 3 wires.

1-12. ORDER OF WORK. - The contractor shall at all times keep the contracting officer informed of the order of proposed operations. To this end, in addition to the charts required to be submitted in accordance with paragraph 16-d of the Invitation for Bids, the contractor shall furnish such supplementary charts and/or other information regarding proposed future operations as may be required by the contracting officer.

1-13. RIGHT-OF-WAY. - The right-of-way for the work covered by these specifications will be furnished by the Government.

### 1-14. ROADS AND GROUNDS.

(a) The contractor shall have the privilege of using the Government-controlled land within the work areas shown on sheet No. 2 of the drawings, except for that part of said lands as may be reserved by the contracting officer for other purposes.

(b) At any time during the progress of the work the contractor shall, when so directed by the contracting officer, promptly vacate and clean up, within 60 days after written notice, without expense to the Government, any part of the grounds which have been in use by him when such grounds are needed for other purposes. The contractor shall keep the buildings and grounds in use by him at the site of the work in an orderly and sanitary condition and shall provide suitable extinguishers or other fire-fighting apparatus for ready use in all buildings erected or in use by the contractor on Government property.

(c) The contractor shall not obstruct any existing roads on the lands controlled by the United States and shall maintain all roads in the vicinity of the work in as good condition as exists at the time of commencement of the work.

(d) The contractor shall construct temporary access roads from the existing roads on both sides of the river to the site of the work. The United States will furnish the necessary rights-of-way from existing roads on the United States side to the navigation canal and the east abutment. Arrangements for temporary access road or roads on the Canadian side of the river must be made with the Canadian authorities.

The details of construction of the temporary access roads shall be subject to the approval of the contracting officer. The roads shall be maintained by the contractor in such condition as to provide suitable and safe access for the general public to the observation platform and to the Government field office

No separate payment will be made for the construction and maintenance of temporary access roads.

(e) The contractor will be required to construct a covered wooden observation platform having an area of about six-hundred (600) square feet for the use of the general public. This platform shall be constructed at a location selected by the contracting officer. The contractor shall also provide suitable and safe access to the observation platform for the general public so that it may observe the work in progress. No separate payment will be made for this work.

## 1-15. CAMP CONSTRUCTION AND SUPERVISION.

(a) The construction, operation and maintenance of facilities for the quartering and subsisting of the contractor's employees will be subject to the approval of the contracting officer if the facilities are located on Government property. The contractor will be permitted to construct such facilities on the right-of-way owned by the Government only at such locations specifically approved by the contracting officer. The type of construction and design for the buildings erected by the contractor will be subject to the approval of the contracting officer. Expensive or permanent types of construction will not be required, but no unsightly, unsanitary shacks or shanties will be permitted. The contractor will be required to comply with State and local laws relative to police and sanitary measures and with other protective measures imposed by the contracting officer in the administration of his camps. In the event of noncompliance with such laws and regulations, the contracting officer will enforce them at the expense of the contractor. The contracting officer may require the contractor to discharge any employee from the work for violation of camp regulations. (See paragraph 1-21).

(b) In the event the contractor makes arrangements with landowners, other than the Government, near the site of the work for the construction of temporary facilities for the quartering and subsisting of his employees, he will be subject, in the operation and maintenance of such a camp, to all the provisions of subparagraph (a) above with respect to the requirements for compliance with all State and local laws relative to police and sanitary measures, and with measures such as safety, fire hazard and protection, etc., imposed by the contracting officer. In the event of noncompliance with such laws and regulations while operating and maintaining a temporary camp not on the Government-owned or controlled property, the contracting officer will enforce them at the expense of the contractor. The contracting officer may require the contractor to discharge from the work any employee for violation of camp regulations, notwithstanding the fact that the camp may not be located on Government-owned or controlled property.

(c) In the event the contractor provides subsistence for his employees, he shall also provide subsistence to such Government employees as may require such accommodations and at the same rates charged his own employees.

(d) No business or recreational facilities shall be established or operated on Government-owned or controlled lands without the written approval of the contracting officer.

## 1-16. BORROW PITS.

(a) Should the contractor locate deposits of bank run sand and gravel or other materials within the Government-controlled area in the reservoir or adjacent to the site, which are satisfactory to the contracting officer, he may, on approval of the contracting officer use such deposits. No charge will be made to the contractor for materials authorized to be taken from Government-controlled lands and used in the work covered by these specifications. All borrow pits shall be left in a neat and sightly condition, and all pits above the normal ground water table shall be adequately drained. Side slopes shall be not steeper than 1 on 3. No separate payment will be made for such work.

(b) Approval of material sources by the contracting officer shall not constitute approval of all materials taken from such deposits and the contractor will be responsible for the quality of all material used in the work.

(c) Should the contractor obtain materials from deposits on private lands he shall pay any royalties or other charges required, and the contracting officer assumes no responsibility for such use, and the Government will not be obligated in any way.

1-17. DATUM AND REFERENCE BENCH MARKS. - The plane of reference used in these specifications and on the drawings is Mean Sea Level. Elevations referring to this datum plane are to be determined from the following bench mark: See Bulletin 514, Results of Spirit Leveling in New York, U. S. Geological Survey, Page 60. Tilden, on north side of river road, on town line between Lisbon and Waddington, on Southeast face of post office, 7.2 feet from south corner. 0.8 foot above ground; center punch mark in brass bolt cemented into foundation stone marked "U.S." (U. S. Corps of Engineers 13). Elevation 269.953.

## 1-18. PHYSICAL DATA.

(a) Foundation data. - Investigations, including surveys, borings, test trenches, pits and test shafts made at the site by the United States to determine the character of the foundation materials are shown on the drawings referred to in paragraph 1-04.

The United States does not guarantee that other materials will not be encountered nor that the proportions of the several materials will not vary from those indicated by the explorations. Bidders are expected to examine the site of the work, the logs of boring, test pits, probings, and the cores and samples which are available at the U. S. Engineer office, Massena, New York, and, after investigation, decide for themselves the character of the materials and make their bids accordingly.

(b) Weather Conditions. - Meteorological data in the form of rainfall snow, and temperature records, prepared from records covering a period of 33 years (1907 to 1939, inclusive), of the U. S. Weather Bureau Station at Canton, New York, approximately 20 miles south of the site of the work, are as follows:

| | Temperature Degrees Fahrenhiet | | | Precipitation (Mean Monthly) | |
|---|---|---|---|---|---|
| Month | Mean Monthly | Extreme Max. | Extreme Min. | Total Inches | Inches Snow |
| January | 16.8 | 61 | -41 | 2.64 | 14.9 |
| February | 15.8 | 63 | -43 | 2.30 | 15.5 |
| March | 27.9 | 78 | -30 | 2.60 | 13.1 |
| April | 41.7 | 85 | -1 | 2.59 | 4.9 |
| May | 54.2 | 93 | 21 | 3.03 | 0.2 |
| June | 63.5 | 97 | 30 | 3.51 | 0 |
| July | 38.8 | 99 | 34 | 3.62 | 0 |
| August | 66.5 | 96 | 35 | 3.42 | 0 |
| September | 58.8 | 91 | 25 | 3.44 | 0.1 |
| October | 47.4 | 83 | 14 | 3.04 | 1.0 |
| November | 35.0 | 75 | -15 | 3.02 | 7.5 |
| December | 21.4 | 61 | -37 | 2.62 | 14.5 |

(c) St. Lawrence River Water Temperature. - The St. Lawrence River water temperatures prepared from records covering a period of 8 years (1933 to 1940, inclusive) of the City Engineer, Ogdensburg, New York, are as follows:

Water Temperature
Degrees Fahrenheit

| Month | Mean Monthly | Extreme Max. | Extreme Min. |
|---|---|---|---|
| January | 32.7 | 36 | 32 |
| February | 32.9 | 37 | 32 |
| March | 33.0 | 37 | 32 |

| Month | Mean Monthly | Extreme Max. | Extreme Min. |
|---|---|---|---|
| April | 36.2 | 46 | 32 |
| May | 46.9 | 60 | 37 |
| June | 58.8 | 66 | 49 |
| July | 65.5 | 73 | 59 |
| August | 70.5 | 74 | 63 |
| September | 64.6 | 72 | 59 |
| October | 56.4 | 65 | 50 |
| November | 46.5 | 52 | 37 |
| December | 35.7 | 44 | 32 |

The above data are included for the information of the contractor. The Government assumes no responsibility for their completeness or accuracy or for deductions, interpretations, or conclusions drawn therefrom.

(d) River Stages. - The mean flow of the St. Lawrence River during the period 1860 to 1940 was 237,000 c.f.s. The maximum monthly mean discharge during the period was 314,000 c.f.s. and the minimum 144,000 c.f.s. the gage elevations at lock 25, about one mile below the damsite, corresponding to the above discharges are Elevation 228.26, mean; 233.4, maximum; and 221.0, minimum. The standard low water datum is elevation 225.38, for a discharge of 197,000 c.f.s. Water surface elevations at the damsite will be approximately 3 feet above those at lock 25.

(e) Utilities. - In the event that power lines, telephone or telegraph lines, pipe lines, cables, or other utilities are encountered with in the limits of the work including the access right-of-way, the contractor shall notify the contracting officer in writing of any necessary changes in such utilities not less than 30 days in advance of the date he desires such changes made. The contracting officer will arrange for the relocation or reconstruction of such utilities by other agencies, or will authorize the contractor to remove them, at no extra cost to the Government, to the extent required for excution of the contract work.

1-19. TRANSPORTATION FACILITIES. - The following data on transportation facilities is furnished for the information of the contractor but the Government assumes no responsibility for its completeness or accuracy and the contractor is expected to investigate the conditions and determine for himself the probable transportation facilities available.

(a) Railroads. - The Canadian National Railway serves the town Iroquois, Ontario, which lies approxiamately one mile from the site of the Canadian end of the Iroquois Dam. The Norwood and St. Lawrence Railroad serves the village of Waddington, N. Y., approximately five miles east of the dam site. The Rutland Railroad passes the dam site approximately eight miles to the south.

(b) New York State Highway No. 37 between Waddington and Ogdensburg approaches within approximately two miles of the dam site. Kings Highway No.2 on the Canadian side approaches within approximately one mile of the dam site.

(c) Water. - The lower end of Galop canal is at Iroquois, Ontario, approximately one mile from the dam site. Locks in the Galop canal generally limit the size of craft to widths less than 45 feet, lengths less than 270 feet, and drafts less than 14 feet. For a detailed description of the existing canal and lock clearances and depths, the contractor is referred to the booklet "The Canals of Canada", published by the Department of Transport, Ottawa, Ontario, Canada, copies of which are available for inspection in the U. S. Engineer Office, Massena, N. Y. The navigation season is usually limited by ice conditions to the period from April 20 to December 1.

### 1-20. ORGANIZATION, PLANT AND PROGRESS.

(a) The contractor shall perform, directly and without subcontracting, not less than fifty percent (50%) of the work to be calculated on the basis of the contract price.

(b) The contractor shall employ an ample force of preoperly experienc men and provide a construction plant properly adapted to the work and of sufficient capacity and efficiency to accomplish the work in a safe and workmanlike manner at the rate of progress specified in his bid. All plant shall be maintained in good working order and provision shall be made for immediate emergency repairs. No reduction in the capacity of the plant employed on the work shall be made except by written permission of the contracting officer. The measure of the "capacity of the plant" shall be its actual performance on the work to which these specifications apply. It is understood that award of this contract shall not be construed as a guaranty by the United States that plant listed in statement of contractor for use on this contract is adequate for the performance of the work.

(c) Should the contractor fail to maintain the rate of progress proposed in his bid, the contracting officer may require that additional men or plant, or both, be placed on the work, working if necessary during additional periods, or a reorganization of plant layout be effected in order that work be brought up to schedule and maintained there. Should the contractor refuse or neglect so to increase the number of men or plant, or both, or to reorganize the plant layout in the manner satisfactory to the contracting officer, the latter may proceed under the provisions of Article 9 of the contract.

### 1-21. LIABILITY AND SAFETY REQUIREMENTS.

(a) Accident Prevention. - In order to protect the life and health of employees in the performance of this contract, the contractor will comply with all pertinent provisions of the "Safety Requirements in Excavation - Buildi Construction" approved by the Chief of Engineers, December 16, 1941, (a copy of which is on file in the office of contracting officer) and as may be amended, and will take or cause to be taken such additional measures as the contracting officer may determine to be reasonably necessary for this purpose. The contractor will maintain an accurate record of and will report to the contracting officer in the manner and on the forms prescribed by the contracting officer, all cases of death, occupational disease and traumatic injury arising out of or in the course of employment on work under this contract. The contracting offic will notify the contractor of any non-compliance with the foregoing provisions and the action to be taken. The contractor shall, after receipt of such notice, immediately correct the conditions to which attention has been directed. Such notice, when served on the contractor or his representative at the site of the work, shall be deemed sufficient for the purpose aforesaid. If the contractor fails or refuses to comply promptly, the contracting officer may issue an order stopping all or any part of the work. When satisfactory corrective action is taken, a start order will be issued. No part of the time lost due to any such stop order shall be made the subject of claim for extension of time or for excess costs or damages by the contractor.

(b) The contractor will not be allowed to block or obstruct any public highway without having secured prior permission from the contracting officer, and he shall provide safe, temporary detours. During the time the public highways may be so blocked, the contractor shall place danger lights, barricades and warning signs in accordance with the laws of the State of New York.

(c) The contractor shall be responsible that his employees strictly observe the laws of the United States affecting all operations at the site under the contract. He shall comply with all applicable Federal, State and local laws, including those concerning the inspection of boilers and other equipment, the licensing of engineers and other employees.

(d) The United States will not be responsible for any damage to or increased difficulties in performance of the work under this contract on account of any scour or other changes in the river bed or banks or water currents resulting from other construction at the site, and no payments, allowances or deductions will be made for or on account of any such damage or difficulties.

(e) Nothing in this paragraph shall be construed as modifying the responsibility of the contractor as set forth in Article 10 of the contract.

1-22. LIGHTS. - The contractor shall, at his own expense, display proper lights continuously each night, between the hours of sunset and sunrise and during fogs, upon cofferdams, all floating plant connected with the work, and all ranges and other stakes in connection with it, when necessary in the opinion of the contracting officer, and shall be responsible for all damages resulting from any neglect or failure in this respect. If work is done at night the contractor shall maintain, from sunset to sunrise, such lights on or about his plant as the contracting officer may deem necessary for the proper observation of the operations.

1-23. USE OF EXPLOSIVES. - The contractor shall use the utmost care in the use of explosives necessary for the presecution of the work, not to endanger life or property. All blasting operations shall be conducted by experienced men only. The handling and use of explosives shall be done strictly in accordance with the latest methods and rulings to insure safety, in accordance with the specifications issued by the U. S. Bureau of Mines, and in compliance with the local and State laws. Failure to observe necessary precautions will be sufficient grounds for temporary suspension of the work. All explosives shall be transported and stored in a secure manner, and in accordance with local and State laws; all vehicles and such storage places shall be marked clearly "DANGER - EXPLOSIVES," and shall be in the care of competent watchmen at all times. In no case shall caps or other detonators be stored or transported with dynamite or other explosives. The location of magazines for the storage of explosives and for the separate storage of detonators shall be subject to the approval of the contracting officer.

1-24. PROPERTY DAMAGE. -

(a) Damage to Government property or to the works due to failure of the contractor to carry out the terms of the contract and specifications, to take reasonable precautions, or to maintain progress to approved schedules, or to carry out the instructions of the contracting officer shall be made good by the contractor without expense to the United States. He will also be held responsible for any damage done to adjoining property through his neglect or failure to take proper precautions (see Article 10 of the contract).

(b) The contractor will not be held responsible for damage sustained by the permanent work from accident, flood, or exposure where such damage is not due to his fault or negligence and where the work is being conducted in accordance with the terms and schedule of the contract and specifications, but he shall make such repairs as the contracting officer may direct to such damaged portions of the work, at the applicable contract unit prices for the various items of work.

1-25. INSPECTION.

(a) The work will be conducted under the general direction of the contracting officer and will be inspected in accordance with Article 6 of the contract by inspectors appointed by him. The inspectors will keep a record of the work done and see that the location and limit marks are kept in proper order, but the presence of the inspector shall not relieve the contractor or his responsible agent (see Article 8 of the contract) of responsibility for the proper execution of the work.

(b) Should the contractor refuse, neglect or delay compliance with the requirements concerning facilities for inspection and layout (see paragraph 1-26), the specific facilities may be furnished and maintained by the contracting officer, and the cost thereof deducted from any amounts due or to become due the contractor.

(c) Except as specified in this paragraph, in Article 6 of the contract, and in paragraphs 1-31 (d) and 1-26, all expenses of inspection will be borne by the United States.

(d) The contractor shall furnish a suitable room containing at least 150 square feet of floor space, at his concrete mixing plant for a Government laboratory to be used for temporary storage of concrete cylinders, and determination of moisture content of the concrete aggregate. This room shall be protected from the weather, properly lighted, provided with necessary work tables and benches, and shall be heated if concrete work is done in cold weather. The location for this room shall be subject to the approval of the contracting officer. The contractor shall provide, during the construction period, electricity for light and miscellaneous uses, see paragraph 1-11 (b), and an adequate supply of water for drinking and sanitary purposes in the Government field office, constructed in accordance with Section XI of these Specifications.

(e) Portable Buildings. - The contractor shall furnish two suitable portable buildings, located as required by the contracting officer within the site of the work, for use by the Government. These buildings shall be approximately 10 feet by 12 feet and shall be supplied with an instrument rack, a built-in desk, clothes lockers, supply cabinet with lock, bench and such other appurtenances as may be required by the contracting officer. The buildings may be of any type construction as approved by the contracting officer and shall be movable, as the contracting officer may require them to be shifted during progress of the work. They shall be reasonably weatherproof, and shall be supplied with heat and electric lights without cost to the Government.

(f) It is understood that any instructions, or decisions given by a superior officer, through the contracting officer, are to be considered instructions or decisions of the contracting officer, in all cases where, under the terms of this contract, decision rests with the contracting officer.

1-26. LINES, GRADES AND MEASUREMENTS.

(a) The work shall be carried out in strict accordance with line, grades, and dimensions shown on the drawings or as directed from time to time by the contracting officer.

(b) The contractor shall, at his own expense, furnish all stakes, templates, patterns, platforms and special labor that may be required in setting and cutting, or laying out any part of the work.

(c) The contracting officer will furnish the control points, lines, grades, and elevations necessary to enable the contractor to perform the construction work. After this layout has been made by the contracting officer, it shall be the responsibility of the contractor to supply and maintain all additional survey points, grade stakes, form locations and other work lines necessary for the proper execution and conduct of the work. From time to time during the progress of the work, the contracting officer will check the contractor's lines and grades to determine whether or not the work is being accurately and properly executed, but such checks will in no way relieve the contractor of the responsibility for executing the work in accordance with the plans and specifications, and the original field layout furnished by the contracting officer.

(d) Bench marks, triangulation stations, and principal control points shall be preserved by the contractor and in case of their destruction or removal by him or his employees, they will be replaced by the contracting officer at the contractor's expense.

1-27. CHANGES AND CHANGED CONDITIONS. - When changes are made in the specifications or drawings, or changed conditions are encountered during the progress of the work, which cause an increase or decrease in the amount due under the contract, or in the time required for its performance, an equitable adjustment shall be made in accordance with Articles 3 and 4 of the contract.

1-28. MINOR MODIFICATIONS. - The right is reserved to make such minor changes in the execution of the work to be done under these specifications as, in the judgment of the contracting officer, may be necessary or expedient to carry out the intent of the contract; provided, that the unit cost to the contractor of doing the work shall not be increased thereby, and no increase in unit price over the contract rate will be paid to the contractor on account of such changes. (See Articles 3, 4, and 5 of the contract.)

## 1-29. CLAIMS, PROTESTS AND APPEALS.

(a) If the contractor considers any work demanded of him to be outside the requirements of the contract or if he considers any action or ruling of the contracting officer or of the inspectors to be unfair, the contractor shall without undue delay, upon such demand, action, or ruling, submit his protest thereto in writing to the contracting officer, stating clearly and in detail the basis of his objections. The contracting officer shall thereupon promptly investigate the complaint and furnish the contractor his decision, in writing, thereon. If the contractor is not satisfied with the decision of the contracting officer, he may, within thirty days, appeal in writing to the Secretary of War, whose decision or that of his duly authorized representative shall be final and binding upon the parties to the contract. Except for such protests or objections as are made of record in the manner herein specified and within the time limit stated, the records, rulings, instructions or decisions of the contracting officer shall be final and conclusive.

(b) All appeals from decisions of the contracting officer authorized under the contract shall, be addressed to the Secretary of War, Washington, D. C. The appeal shall contain all the facts or circumstances upon which the contractor bases his claim for relief and should be presented to the contracting officer for transmittal within the time provided therefor in the contract.

1-30. PATENTS. - The contractor shall hold and save the Government, its officers, agents, servants and employees, harmless from liability of any nature or kind, including costs and expenses for or on account of any patented or unpatented invention, article or appliance manufactured or used in the performance of this contract, including its use by the Government.

## 1-31. STANDARD TESTS, QUALITY AND GUARANTEES.

(a) All materials furnished by the contractor, supplies and parts, and assemblies thereof, entering into the work to be done under these specifications, shall be tested as specified herein, or if not specified, in conformity with Article 6 of the contract and according to the best modern approved methods for the particular type and class of work.

(b) Unless otherwise authorized or directed, where standard published specifications of recognized authorities or organizations are specified, the latest revision of such specifications current at the time the work is executed shall govern.

(c) Unless waived in writing by the contracting officer, all tests an trials shall be made in the presence of a duly authorized representative of the contracting officer. When the presence of the inspector is so waived, sworn statements, in triplicate, of the tests made and the results thereof, shall be furnished the contracting officer by the contractor as soon as possible after the tests are made.

(d) All costs of all tests and trials, excepting the expenses of the Government inspector, shall be borne by the contractor and shall be included in the contract price, unless specified otherwise.

(e) In accordance with Article 7 of the contract, all materials, supplies and articles furnished and incorporated in the permanent structure shall be of the highest grade, free from defects and imperfections, of recent manufacture, and unused. Workmanship shall be of the highest grade and in accordance with the best modern standard practice.

(f) All articles, supplies, equipment, parts and assemblies thereof, of standard manufacture, or for which detail design or requirements are not prescribed in these specifications shall be guaranteed by the contractor against any failure in proper use or operation, caused by defective material, workmanship or design, for a period of one year from the date of final acceptance of the complete work under this contract. Failure in any part due to such causes within that time shall be promptly and satisfactorily remedied by the contractor without cost to the United States.

1-32. PROTECTION OF STORED MATERIALS. - All materials, supplies and articles delivered at the site shall be adequately housed or otherwise protected against deterioration and damage to the satisfaction of the contracting officer. When material stored at the site and partly paid for is not adequately protected by the contractor, such material will be kept protected by the contracting officer at the expense of the contractor, and no partial payments will be made upon future delivery of the articles or commodities in question.

1-33. MISPLACED MATERIAL. - Any material that is deposited elsewhere than place designated or approved by the contracting officer will not be paid for, and the contractor may be required to remove such material and waste it or redeposit it as directed.

1-34. STANDARD STOCK PRODUCTS.

(a) All materials, supplies and articles furnished shall, wherever so specified, and otherwise wherever practicable, be the standard stock products of recognized reputable manufacturers. The standard stock products of manufacturers other than those specified will be accepted, when it is proved to the satisfaction of the contracting officer that they are equal in strength, durability, usefulness and convenience for the purpose intended (see Article 7 of the contract). Any changes required in the details and dimensions shown on the drawings for the substitution of standard stock products, other than those provided for, shall be properly made as approved by the contracting officer, and at the expense of the contractor. The references herein to brands and catalog numbers are intended to be descriptive and not restrictive, and are used only to indicate articles that will be satisfactory. Other makes and catalog numbers will be accepted provided that they are similar and equal to those specified herein or called for on the drawings.

(b) Data to be Submitted for Approval. In accordance with Article 7 of the contract, prior to the placing of any purchase order for products of standard manufacture, and sufficiently in advance of the proposed purchase date to enable the contracting office to determine whether the proposed product conforms to the specifications, the contractor shall submit for the approval of the contracting officer complete descriptive data in triplicate, consisting of dimensioned drawings, catalog references and specifications, typical performance records, and such other information as may be required to be submitted on special forms to be furnished by the contracting officer to identify clearly each product in question. The term "or equal" shall not be used in any descriptive information furnished. Except at the contractor's risk, no purchase order shall be placed for any product which has not been approved by the contracting officer.

(c) Final Completion Data. - There shall be supplied 5 complete sets of data, each separately bound in a leather binder, for each major item of equipment furnished and installed under this contract. These data shall consist of all necessary instruction bulletins, complete drawings, complete parts and material lists positively identifying each part, manufacturer's recommendation as to spare parts, and all other necessary data.

## 1-35. PREFERENCE FOR DOMESTIC ARTICLES.

(a) With reference to article 18 of the contract, because the materials listed below, or the materials from which they are manufactured, are not mined, produced, or manufactured, as the case may be, in the United States in sufficient and reasonably available commercial quantities and of a satisfactory quality, their use in the work herein specified is authorized without regard to the country of origin:

Platimum
Chromium
Cork
Jute
Kaurigum
Lac
Asphalt
Nickel
Rubber
Teak Wood
Silk
Sisal
Tin
Aluminum
Asbestos
China Wood Oil (Tung Oil)
Balsa Wood
English Ball Clay
English China Clay
Natural Copper-Nickel Alloy
Diamonds

(b) Articles, materials or supplies manufactured in the United States and containing mercury, antimony, tungsten or mica of foreign origin may be used in the work herein specified because such manufactured articles, materials, or supplies have been manufactured in the United States substantially all from articles, materials, or supplies, mined, produced or manufactured, as the case may be, in the United States.

1-36. INTERFERENCE WITH OTHER CONTRACTORS. - Other contractors will perform work on the Iroquois Dam pertaining to installing and placing electrical equipment, and operating equipment. In addition other major work will be undertaken in the vicinity at approximately the same time, such as Point Rockway Lock and the part of the canal not in this contract. The contractor shall not interfere with material, appliances or workmen of the United States or of any other contractor who may have work at this site. As far as practicable, all contractors shall have equal rights to the use of all roads, grounds, and adjacent river, and make equitable agreements among themselves for the use of temporary railroads and highways. In case of disagreement regarding such use, the decision of the contracting officer shall govern. (See Article 13 of the contract.)

1-37. RESTORATION OF SITE. - Before final payment is made, the contractor shall remove from the site, without expense to the United States, all rubbish and unused materials provided by him, temporary buildings, cofferdams and other structures erected by him, shall fill all holes or cavities made for his convenience, except as otherwise provided, and shall leave the whole site in good order and condition, all as required by the contracting officer.

## 1-38. WAGE AND LABOR PROVISIONS.

(a) Pursuant to the provisions of Article 17 of revised United States Standard Form No. 23 the following wage rates have been determined by the Department of Labor:

### SCHEDULE OF WAGE RATES

| Classification | Minimum Rate per Hour |
|---|---|
| Blacksmith | |
| Blacksmith Helper | |
| Boilermaker | |
| Boilermaker Helper | |
| Bricklayer | |
| Bricklayer Tender | |
| Carpenter (Skilled) | |
| Carpenter, Apprentice, 1st year | |
| Carpenter, Apprentice, 2d year | |
| Carpenter, Apprentice, 3d year | |
| Concrete Finisher (Rough concrete) | |
| Concrete Form Stripper | |
| Concreteman (Puddler, Screeder, Vibratorman & Curing) | |
| Conveyor Tender | |
| Deckhand (Dredge) | |
| Dumpman (Spotter & Grademan) | |
| Electrician | |
| Electrician Helper | |
| Engineman (Stationary Power Plants) | |
| Fireman | |
| Glazier | |
| Hooktender (Concrete Placement) | |
| Laborer (Common) | |
| Laborer (Dredge) | |
| Machinist | |
| Machinist Helper | |
| Mason (Stone) | |
| Mechanic | |
| Mechanic Helper | |
| Millwright | |
| Motorman (Dinky) | |
| Oiler | |
| Operators of Power Equipment: | |
| Air Compressor (over 750 c.f.m.) | |
| Air Compressor (750 c.f.m. and under) | |
| Air Hammer (Jackhammer, Pavement Breaker, etc.) | |
| Cement Pump | |
| Concrete Batching Plant | |
| Concrete Mixer | |
| Concrete Pump | |
| Core Drill | |
| Crane (except Gantry Crane) | |
| Derrick | |
| Dragline | |
| Elevating Grader | |
| Gantry Crane | |
| Grader (Finish) | |
| Grader (Rough) | |
| Grout Machine | |
| Hoist | |
| Launch Operator (150 H.P. or under) | |

## SCHEDULE OF WAGE RATES (CONTINUED)

Classification                                        Minimum Rate per Ho

Pile Driver
Power Saw
Power Scraper
Pump (100 H.P. or over)
Pump (under 100 H.P.)
Screening Plant
Shovel
Tractor (under 35 H.P. without attachments)
Tractor (35 H.P. and over, and all tractors with attachments)
Painter
Pile Drivermen, Leadsmen, Linesmen, Nozzlemen, Winchmen
Pipe Fitter
Pipe Fitter Helper
Plasterer
Plasterer Tender
Plumber
Plumber Helper
Powderman
Powderman Helper
Reinforcing Steel Worker
Rigger
Roofer
Sheetmetal Worker
Signalman, Concrete Placement (Phone man)
Structural Steel Worker
Structural Steel Worker Helper
Teamster (2 up)
Teamster (4 up or more)
Tool Dresser
Truck Driver (under 4 tons)
Truck Driver (4 tons to 10 tons)
Truck Driver (over 10 tons)
Welder (Certified - structural steel)
Welder (Certified - other than structural steel)
Welder's Helper

(b) Each class of laborer and mechanic specified in the above schedu shall receive not less than the minimum rate of wages specified therein, except that deductions from wages paid may be made as required by any laws now or hereinafter in force, in the state in which this project is situated, calling for contributions by employees from earnings to funds maintained in the administration of an unemployment compensation law under the Social Security Act. In the event that it becomes necessary to employ any laborer or mechanic whose work is not covered by any of the classifications in said schedule, he shall be paid not less than the prevailing rate of wages for the class of work done by him. Such rate shall be predetermined by the contracting officer. In case any dispute arises as to what are the prevailing rates of wages for work of a similar nature which cannot be adjusted by the contracting officer, the matter shall be referred to the Secretary of Labor for determination and his decision thereon shall be conclusive on all parties hereto.

(c) The contractor will be required to furnish identification badges for all his employees. These badges will show the employee's photograph, printed name, and signature, and will be of a design approved by the contracting officer.

(d) The contractor, in performing the work required by this contract, shall not discriminate against any worker because of race, creed, color, or national origin.

(e) The contractor agrees that the provisions of paragraph (d) above will also be inserted in all of his subcontracts. For the purpose of this article a subcontract is defined as any contract entered into by the contractor with any individual, partnership, association, corporation, estate, or trust, or other business enterprise or legal entity, which involves performance, wholly or in part at the site of the work, of some part of the work to be performed under this contract.

1-39. REPORTS TO DEPARTMENT OF LABOR. - The contractor will report monthly, and will cause all subcontractors to report in like manner, within five days after the close of each calendar month, on forms to be furnished by the Department of Labor the number of persons on their respective payrolls, the aggregate amount of such payrolls, the man hours worked, and the total expenditures for materials. He shall furnish to the Department of Labor the names and addresses of all subcontractors on the work at the earliest date practicable, provided that the foregoing shall be applicable only to work at the site of the construction project. Copies of all data furnished the Department of Labor shall be promptly furnished the contracting officer.

1-40. INVOICES. - The contractor shall furnish the contracting officer with copies of all invoices for the purchase of materials, supplies and plant in connection with the work to be performed under these specifications. The contractor's records shall be subject to inspection by the contracting officer to verify the accuracy and completness of the information furnished.

1-41. COST DATA. - The Government will keep a record of the costs of the work performed under these specifications and the contractor shall permit the contracting officer to have access to his timekeeping, invoices and plant records for this purpose. The contractor shall also furnish the contracting officer with a statement of the initial cost and date of purchase of all plant used in connection with the work.

1-42. ADJUSTMENT OF CONTRACT PRICE BY REASON OF CHANGE IN FEDERAL, STATE OR LOCAL TAXES. - The contract price will be considered to include all Federal, State and local taxes imposed prior to the date of opening bids and applicable to the undertaking. If any privilege, sales, gross receipts or other tax (exclusive of taxes on net income or undistributed profits), applicable to the undertaking and payable directly by the contractor, is imposed or changed after the date of opening bids by Federal or State enactment, then the contract price will be increased or decreased accordingly and any amount due or chargeable against the contractor as a result thereof will be adjusted on payment vouchers as separate items.

1-43. SUBCONTRACTORS. - Subcontractors and their employees shall be considered to be employees of the contractor as the term "employee" is used in these specifications.

1-44. SITE OF WORK. - The term "Site of the Work", as used in these specifications and in Articles 17 and 19 of the contract, will embrace all areas wherein field operations are conducted by the contractor in connection with this contract, including work areas, shops, yards, camps, etc., irrespective of whether such operating areas lie within the limits of work areas or rights-of-way shown on the drawings.

1-45. ASSIGNMENT OF CLAIMS. - The Act of October 9, 1940 (Public No. 811, 76th Congress) provides that Sections 3477 and 3737, Revised Statutes, shall not apply to any case in which the moneys due or to become due from the United States, under a contract providing for payments aggregating $1,000 or more, are assigned to a bank, trust company, or other financing institution, including any Federal lending agency. An assignment may be made under this contract, pursuant to the Act of October 9, 1940, cited above, and subject to the further provision stated below:

(a) Any assignment shall cover all amounts payable under this contract and not already paid and shall not be made to more than one party, except that any such assignment may be made to one party as agent or trustee for two or more parties participating in such financing.

(b) Any claim under this contract which may be assigned may be subject to further assignment to a bank, trust company, or other financing institution, including any Federal lending agency, and to similar further assignment; provided, that any such assignee shall file written notice of the further assignment together with a true copy of the instrument of further assignment with the contractor and also as provided in proviso 4 of section 1 of the Assignment of Claims Act of 1940 (Public No. 811, 76th Congress) in respect of original assignment.

(c) No assignee shall divulge any information concerning the contract, or contained therein, except to those persons necessarily concerned with the transaction.

(d) Payments to an assignee of any claim arising under this contract shall not be subject to reduction or set off for any indebtedness of the assignor to the United States arising independently of this contract.

1-46. ADJUSTMENT OF PRICES FOR LABOR AND MATERIAL.

(a) The following terms used hereafter are defined as follows:

(1) "Basic hourly earnings index" shall be determined by adding monthly average hourly earnings in the "_______________" industry as indicated under heading "___________________________" in the monthly pamphlet "Hourly Wages and Labor Employment" issued by the Department of Labor for: the month in which contract time commences, the five (5) months preceding such month, and the six (6) months succeeding such month; and then dividing this total by twelve (12).

(2) "Basic materials index" shall be determined by method in (1) above, using monthly indices for item "_________________________________" in the monthly pamphlet "Wholesale Prices" issued by the Department of Labor.

(3) "Monthly labor adjustment index" shall be determined from monthly average hourly earnings indentified as to source in (1) above as follows: Add the average hourly earnings for the month for which adjustment is being made, the two preceding months and the two succeeding months; and then divide this total by five (5).

(4) "Monthly materials adjustment index" shall be determined by method in (3) above, using monthly indices identified as to source in (2) above.

(5) Above contract indices in (1), (2), (3), and (4) shall be computed to nearest second decimal place, taking the decimal point as located in indices issued by the Department of Labor. When third decimal place computes to 5 or over, the figure in second decimal place shall be raised to next higher figure.

(b) (1) The proportion of the contract price represented by labor, subject to adjustment in price, is accepted as ______________________________ per cent of the contract price.

(2) The proportion of the contract price represented by materials, subject to adjustment in price, is accepted as _________________________ per cent of the contract price.

(c) (1) The labor cost for entire contract as determined in (b) (1) above shall within thirty (30) days after receipt of notice to proceed, be divided into monthly labor cost quotas, prepared by the contractor and subject to the approval of the contracting officer, for each partial or whole calendar month of the contract time beginning with the notice to proceed.

(2) The materials cost for entire contract as determined in (b) (2) above shall be similarly divided into monthly materials cost quotas within thirty (30) days after receipt of notice to proceed.

(d) Adjustments in payments shall be obtained for each monthly cost quota as follows:- Multiply monthly cost quota by the appropriate monthly adjustment index, divide by corresponding basic index, and subtract monthly cost quota. The result shall be added to or deducted from payments to the contractor.

(e) (1) If the time for performance of this contract is legally extended by the contracting officer there shall be immediately set up by the contractor, subject to the approval by the contracting officer, new monthly cost quotas as necessary. These new monthly cost quotas may extend back as far as any month for which adjustments in payments have not been completed, but the total of the new quotas shall not exceed the total of the old quotas for which adjustments in payments have not been completed.

(2) If there is an increase or decrease in the work originally contemplated under this contract, there shall be immediately set up by the contractor, subject to the approval of the contracting officer, new monthly costs quotas for months concerned.

(3) If liquidated damages are assessed against the contractor under the contract, such liquidated damages shall not be considered in making adjustments.

(f) The adjustment payment or deduction for any one month shall normally be included with next partial contract payment after receipt of Department of Labor indices for such month.

(g) The acceptance and final payment for work and/or materials under this contract shall be carried out as elsewhere provided in this contract, and amounts retained for the protection of the Government during construction shall be promptly paid upon final acceptance: Provided, however, that an amount, as determined by the contracting officer, for protection of the Government in adjustments not yet completed, shall be retained; and, provided further, that the release required by ____________________________________ will contain provision excepting such adjustment payments as may become due the contractor.

(h) After final payment for basic contractual price as indicated in paragraph (g) above has been made, adjustments becoming due will be delayed until all indices necessary for completion of all adjustments under the contract are available, when one lump payment or deduction shall be made for such adjustments.

(i) In case the final adjustment in the contract price results in a net deduction from the contract price, the contractor and his sureties shall be liable for the amount thereof until it is refunded to the Government.

(j) When payment obligations under the contract exceed the contract price as a result of increases in labor and/or materials costs to the extent that available appropriations are exhausted, the Government reserves the right, without further liability to suspend further work under the contract for the account of the Government or to terminate the contract on payment of contractual obligations incurred up to the point of termination.

1-47. FINAL EXAMINATION AND ACCEPTANCE. - When all work called for under this contract has been completed, the contracting officer will make a thorough examination of the same and, if it is found to fully comply with the requirements of the contract, it will be accepted and final payment will be made in accordance with the provisions of Article 16d of the contract.

1-48. APPROVAL. - This contract shall be subject to the written approval of the proper authorities to be designated later and will not be binding until so approved.

## SECTION II

## DIVERSION AND CARE OF THE RIVER

### 2-01. WORK TO BE DONE.

(a) General. - The work included under this section includes all work required in connection with the handling of water during the entire period of the construction of the dam and appurtenant works. The principal items of the work are (1) the construction, maintenance, and removal of cofferdams and other protective works, (2) diversion of the river, and (3) unwatering and maintaining the working areas free from water.

(b) Scope. - Unless otherwise specified or athorized, all work on construction which forms a part of the permanent structure shall be done in areas free from water. The contractor shall construct, maintain, and remove all cofferdams and diversion structures; and shall furnish and operate all necessary pumps and other facilities for unwatering and maintaining the various areas of the work free from water. On completion of the work the contractor shall remove all cofferdams, equipment, and temporary structures as specified herein, dispose of all debris, and restore the work area to a neat and sightly condition. The price bid for each item of the work shall include constructing, handling, placing, maintaining, operating, and removing such work, and furnishing all materials, labor, and equipment required, except as specified herein.

(c) Materials. - The Government will furnish all timbers for timber cribs and all necessary drift pins, bolts, washers, and tie rods (see paragraph 1-10). All other cofferdam materials shall be furnished by the contractor. Borrow areas from which earth fill materials may be obtained will be designated on the plans (see paragraph 1-16). Sufficient rock for rock fill, crib fill, riprap, and derrick stone is available from required excavation in the Point Rockway Canal.

### 2-02. RESPONSIBILITY.

(a) The contractor shall be responsible for the proper construction, handling, placing, maintaining, operating, and removing of all items of the cofferdams and diversion structures and related services. Any part of the temporary or permanent structures which may fail or be damaged due to negligence on the part of the contractor or which may fail or be damaged during the construction and placing of the cofferdams, and any damage resulting therefrom, shall be repaired or replaced and any cleanup of debris shall all be done by the contractor all at his expense. The contractor shall also be responsible for the proper care of materials furnished by the Government and any such materials which are damaged or broken by the contractor during the unloading, storing, or transporting of such materials or in the prosecution of the work shall be replaced by the contractor at his expense.

(b) The Government will be responsible for the design and adequacy of the cofferdams and diversion structures of the plan specified herein and shown on the drawings (hereinafter designated the contracting officer's plan), except for failure or damage resulting from negligence on the part of the contractor. The Government will not be responsible for the design and adequacy of any alternate cofferdam and diversion plan proposed by the contractor as hereinafter specified for alternate cofferdam and/or diversion plans, (paragraph 2-03).

(c) In the event of failure or overtopping of cofferdam or diversion structures where built in accordance with the contracting officer's plan, the contractor shall repair any damage, including cleanup of debris, to any part of the temporary facilities or permanent construction; and he shall be paid for such work in accordance with Articles 3 and 4 of the contract, and the time of contract completion shall be extended by an amount equal to the time lost as determined by the contracting officer. In addition to the payment specified for work done, the contractor shall be paid, as compensation for extra expenses, a lump sum of $15,000 for each such failure or overtopping; provided, that no additional such payment shall be made for a subsequent failure or overtopping occurring prior to resumption of work after a failure or overtopping. No payment will be made for damage to the contractor's equipment or materials.

(d) In the event that it appears probable that the cofferdams may fail or be overtopped, the contractor may be required to flood the cofferdam. In such event he shall be paid for cleanup and repairs and for extra expense and the time of contract completion shall be extended, all as herein provided for failure or overtopping.

(e) The contractor shall repair, in a satisfactory manner, any damage to the permanent structure caused by scour of ice or water; and he shall be paid for such work in accordance with Articles 3 and 4 of the contract.

## 2-03. ALTERNATE COFFERDAM AND/OR DIVERSION PLANS.

(a) Bidders may submit, subject to the approval of the contracting officer, plans for cofferdams and/or diversion other than those specified herein as the contracting officer's plan, but such alternate cofferdams must provide stability, height, watertightness, and working space within the cofferdams at least equal to the contracting officer's plan.

(b) The contractor shall assume full responsibility for the design and adequacy of such alternates, except for overtopping where the cofferdams are built to the elevations required for the contracting officer's plan, and no payment will be made for cleanup or repairs in the event of failure of such alternate cofferdams nor will an extension of the contract time be allowed for time lost. The Government will, however, assume responsibility for overtopping provided that the cofferdams are built to the height specified for the contracting officer's plan, and further provided that any earth and/or rock structure is built to an elevation not less than 2 feet above the elevation specified for a corresponding timber crib structure. In the event of overtopping where cofferdams are built to the specified elevations, payment will be made for cleanup and repairs and for extra expenses, and an extension of contract time will be granted all as provided in paragraph 2-02 of those specifications for failure and/or overtopping. Materials specified to be furnished by the Government for the contracting officer's plan will be furnished for such alternate plans if adopted. All other materials shall be furnished by the contractor.

## 2-04. INTERFERENCE WITH OTHER FUNCTIONS.

(a) Navigation. - The St. Lawrence River normally carries a great deal of traffic during the navigation period of the year, and it is imperative that such navigation be maintained with the least possible interference.

Navigation proceeding upstream past the dam site enters the Galop Canal below the dam site and will not be affected by the construction of the dam. Navigation proceeding downstream, however, normally leaves the Galop Canal at Locks 27 and 28 and follows the river cannel past the dam site. It is possible that it may be desired to continue down-bound navigation in the river channel past the dam site during the first stage of construction, when approximately one-half the channel will be open; and in such event the contractor shall prosecute his work in such manner that he will not block the open channel or in any way interfere with navigation.

(b) The contractor shall maintain on all cofferdams or other structures such warnings, lights, or other signals as may be required for navigation. All floating debris or other materials which may be dangerous to navigation shall be removed from the river and no holding lines, floating equipment, anchor structures, or other obstacles shall be permitted in or across any navigation channel without prior approval of the contracting officer. The contractor shall be responsible for any damage caused by any debris, equipment, or other object which may be carried from the site of the work into any navigation channel.

## 2-05. CONSTRUCTION PROGRAM AND DIVERSION PLAN.

(a) The construction program proposed by the contracting officer contemplates that the dam shall be built in two sections, closing off first approximately one-half of the river channel, then the remainder. During the period when the first section of the channel is closed, that portion of the dam included therein shall be completed, the flow of the river being passed down the open section of the channel. During the period when the remainder of the channel is closed the remainder of the dam shall be completed, the flow of the river being passed through the gate bays of the completed portion of the dam. Each section shall be inclosed by cofferdams, as shown on sheets 9 to 12 of the plans.

(b) Inasmuch as the major source of the rock available for use in the cofferdams will be the required excavation in the Point Rockway Canal, it is anticipated that the section of the structure adjacent to the United States shore will be completed first so that the completed structure may be used as an access road to the second step cofferdams and construction. However, if the contractor so desires, he may elect to construct the section adjacent to the Canadian shore first. In this case any revisions in the layout of the contracting officer's plan of cofferdams necessitated thereby will be made by the Government. The Government will assume responsibility for the design and adequacy of cofferdams constructed according to such revised contracting officer's plan as specified in paragraph 2-02 herein.

## 2-06. COFFERDAMS.

(a) General. - The proposed cofferdam layout and details are shown on sheets 9 to 12 of the plans. In general the cofferdams shall consist of rock-filled timber cribs connected to the shore by rock and earth embankments. The whole shall be founded on the river overburden, which varies from 20 feet to 70 feet in depth and consists of zones of materials varying in composition as shown on sheets 5 to 8 of the plans. Foundation excavation to a firm foundation which will be unlikely to erode during placement of the river arm cribs and toe trenches for cofferdam embankments shall be excavated in the locations and to the base widths and side slopes as shown on the plans. Due to the variable nature of the overburden, it will be necessary that the contracting officer determine at the time of the prosecution of the cofferdam excavation the actual limits to which such excavation must be carried. Excavation within the cofferdam shall leave a berm adjacent to the cofferdams not less than 30 feet in width, or as otherwise determined by the contracting officer as required for conditions encountered, and shall have slopes not steeper than 1½ horizontal to 1 vertical. The contracting officer reserves the right to extend or modify these requirements to provide for the safety of the cofferdams in accordance with conditions encountered in the prosecution of the work.

(b) Cofferdam Layout. - The cofferdams shall be constructed as shown on the plans. Cribs 63 to 65 inclusive, and 66 and 67, all of which are a part of the second step cofferdams, and supplementary cribs 12A and 12B, shall be constructed as a part of the first step cofferdams in order to protect the river arm of the first step cofferdams from scour. Cribs 4 to 7 inclusive and crib 17 are common to both first and second step cofferdams. Cribs 18 to 20 inclusive, which are a part of the first step cofferdams, shall be left in place during the period of use of the second step cofferdams for protection during that period. The second step cofferdams shall be connected to the finished portion of the dam by a timber crib bulkhead as shown on the plans. Timber cribs in the upstream and river arms of the cofferdams shall be constructed to elevation 235 and in the downstream arms to elevation 233. Rock and earth embankments shall be constructed to elevation 237 in the upstream arms and elevation 235 in the downstream arms.

## 2-07. COFFERDAM CONSTRUCTION.

(a) Excavation. - In locations shown on the plans for crib foundation excavation, or as otherwise directed by the contracting officer, the contractor shall excavate the overburden to firm material to the base width and side slopes shown on the plans and to the depth specified by the contracting officer at the time of prosecution of the work. The purpose of such excavation is to remove loose, unconsolidated material which might be eroded during construction and interfere with the proper fitting and placing of the cribs. It is anticipated that the depth of such excavation will be about 5 feet. Toe trenches, to be backfilled with impervious materials, shall be excavated in the locations and to the base widths and side slopes shown on the plans and to the depth determined by the contracting officer at the time of the prosecution of the work. The purpose of such toe trenches is to reduce seepage under the embankment fills.

(b) Timber Cribs (in place). - Cofferdam cribs shall be constructed and placed as shown on sheets 9 to 12 of the plans. The base of each crib shall be shaped, or tailored, in vertical steps equal in height to one horizontal course of timber, to fit the crib foundation as determined by soundings to be taken prior to the construction of the cribs and subsequent to any required excavation. Timbers shall be fastened by means of drift pins or bolts as shown on the plans. Joints in horizontal courses shall be staggered so that two consecutive joints in a vertical plane shall not occur within the limits of one crib pocket and shall be so placed that a butt joint shall not occur immediately under a cross timber. Butt joints shall be fastened by means of splice blocks as shown on the plans. Holes for drift pins shall be bored with a bit 1/16-inch in diameter less than the thickness of the drift pin; holes for bolts shall be bored with a bit equal in diameter to that of the bolt; and holes for tie rods shall be bored with a bit 1/16-inch in diameter larger than the rods. Standard washers shall be used under all bolt heads and nuts which would otherwise come into contact with the wood. Drift pins shall be square in section, square ended, and without taper. The holding line attachments are shown on the plans for the convenience of the contractor. The use of the holding line attachments as shown will not be required, nor will the use of such attachments as shown relieve the contractor of the responsibility for the safety and handling of the cribs during construction and placing.

(c) For cribs exceeding 30 feet in width timber will be furnished in lengths such that not more than one butt joint will be required in any one horizontal member. For cribs up to and including 30 feet in width timbers will be furnished in lengths equal to the width of the crib. Timbers for weight pocket flooring will be furnished in standard lengths closest to the lenghts required.

(d) Bulkhead cribs shall be built in the dry to connect the second step cofferdam to the completed portion of the dam. They shall be protected by a watertight sheathing on the river face as shown on sheet 11 of the plans and shall be connected to the dam and to the outer cribs by a watertight seal.

(e) Steel Sheet Piling. - Steel sheet piling shall be driven in the locations shown on the plans to form a seal in the river overburden. Piles shall be driven to rock or to refusal and shall be interlocked throughout their length to form a continuous wall. Proper precautions shall be taken to prevent interlock rupture or other injury to the piles; and any pile improperly driven or injured in any manner shall be removed and replaced at the contractor's expense. The top of the piles shall be at the elevation specified for the top of the cribs against which they are driven.

(f) After removal from a cofferdam, steel sheet piling shall remain the property of the contractor, and, if in a satisfactory condition, may be re-used by him in another part of the work.

(g) Crib Fill. - Crib fill shall be quarry run rock. Fill shall be placed in the weight pockets at the time of placing the cribs to trim and sink the cribs. After the cribs are in place all pockets shall be completely filled.

(h) Rock Fill, Cofferdam. - The function of the rock fill in embankments is to form an initial fill to the surface of the water so that the flow will be sufficiently stopped to permit placing earth fill. The material may be quarry run rock. It shall be placed to the slopes shown in the plans and to the height of the surface of the water at the time of placing.

(i) Earth Fill, Cofferdam. - Earth fill in cofferdam embankments shall be impervious earth material placed by dumping or by other suitable method. The earth fill shall be well-graded clayey material or silty sand and gravel; and of the material pasing the 1/4-inch screen at least 25 percent by weight shall pass the 200 mesh screen. Material meeting these specifications is available from the borrow areas indicated.

(j) Riprap, Cofferdam. - Riprap shall consist, in general, of stones weighing 250 pounds or more, and not less than 15 pounds, placed to a thickness of 3 feet in a direction normal to the slope of the embankment. No hand placing or sorting shall be required but the finished surface shall conform to the slope lines as shown on the plans. Any rock used to fill depressions or irregularities in the embankment shall be placed at the contractor's expense.

(k) Derrick Stone, Cofferdam. - Derrick stone shall consist of stone weighing not less than 1,000 pounds and having a least dimension not less than one-half the greatest dimension. Derrick stone shall be placed at the toe of the fill against the river arm cribs of the first step cofferdams, as shown on the plans, and at any other location where excessive scour or high velocities of flow make such protection desirable as determined by the contracting officer.

(1) Cofferdam Removal. - After the completion of the work inclosed by the cofferdams or after such work has progressed to a stage where such protection is not required, the cofferdams shall be removed. Any cofferdams within the area required to be excavated for the approach to the Point Rockway Canal, as shown on sheet 12 of the plans, shall be completely removed. All other cofferdams shall be removed to elevation 200. All materials in the cofferdams, including materials furnished by the Government, shall become the property of the contractor and shall be removed by him. Timber cribs may, if desired, be broken up by blasting; provided, that such blasting shall be carried out in such a manner as not to injure the permanent structure and that any damage caused by such blasting shall be repaired by the contractor at his expense. Earth and rock materials removed from the cofferdam may be wasted in the river or in the spoil areas shown on the plans; provided, that such material shall not be permitted to accumulate in piles or mounds nor to an elevation higher than elevation 200 in the river, and further provided that no material shall be wasted in any area provided for navigation channels or in the approach to the Point Rockway Canal. All timbers or other floating material shall be removed from the river and disposed of in a satisfactory manner.

2-08. UNWATERING. - The contractor shall unwater the area inclosed by the cofferdams and shall maintain all parts of the work free from water as required for the prosecution of the work. The contractor shall furnish, install maintain, and operate all pumps and appurtenant equipment, including suitable equipment for measuring the water removed. Pumps for unwatering shall have sufficient capacity to remove the water impounded within the cofferdams of each step in not more than 15 days. The capacity of the pumps provided and the general location and arrangement shall be subject to the approval of the contracting officer, who may order the installation of additional pumps and equipment if, in his opinion, such action is necessary to insure the safety of the structure or to maintain working areas free from water. At such time as the construction of the dam has progressed to an elevation such that further unwatering is not required within a cofferdam, the contracting officer may require that pumping be stopped and no further payment will be made for subsequent unwatering.

2-09. MEASUREMENT AND PAYMENT.

(a) Excavation, Cofferdam. - A survey of the river bed will be made prior to commencement of the work; and measurement for excavation will be made between the ground surface and the slope and grade lines specified or shown on the drawings, and to the depth specified by the contracting officer. Payment for such excavation, including excavation for toe trenches, will be made at the contract unit price per cubic yard for "Excavation; Cofferdam." Excess material excavated outside the limits specified shall not be included for payment.

(b) Timber Cribs (in place). - Payment for timber cribs shall include all work of unloading, transporting, and storing materials, constructing, placing, and maintaining cribs as specified or shown on the drawings, and furnishing all materials not specified to be furnished by the Government. Payment will be made at the contract unit price per thousand board feet for "Timber Cribs. The number of board feet shall include all crib timber in place except sheathing lumber. The computations of footage shall be based on the nominal size of each piece.

(c) Bulkhead Sheathing. - Payment for furnishing and placing bulkhead crib sheathing will be made at the contract unit price per square foot for "Bulkhead Sheathing." This item shall include only the built up watertight sheathing for bulkhead cribs, as specified in paragraph 2-07(d).

(d) Steel Sheet Piling (in place). - Payment for furnishing and placing steel sheet piling will be made at the contract unit price per square foot for "Steel Sheet Piling," for the number of square feet of wall below the specified grade line.

(e) Crib Fill. - Crib fill shall be measured in place to the inside dimension of the crib pockets. Payment will be made at the contract unit price per cubic yard for "Crib Fill."

(f) Earth Fill, Rock Fill, and Riprap. - These items shall be measured in place to the slope and grade lines as specified or shown on the plans. Payment will be made at the contract unit prices per cubic yard for "Earth Fill; Cofferdam," "Rock Fill; Cofferdam," and "Riprap; Cofferdam," respectively.

(g) Derrick Stone. - Derrick stone shall be measured by the ton and the contractor shall furnish scales and a suitable shelter for weighing the material at the site of the work. Payment will be made at the contract unit price per ton for "Derrick Stone; Cofferdams."

(h) Cofferdam Removal. - Cofferdam removal shall be measured on the basis of material actually in place above the grade specified for removal; and no classification of material will be made. Payment will be made at the contract unit price per cubic yard for "Cofferdam Removal" and shall include all work as specified including disposal and cleanup.

(i) Unwatering Cofferdams. - Payment for unwatering cofferdams, including maintaining all parts of the work free from water as required, will be made at the contract unit price per acre foot for "Unwatering Cofferdams."

# SECTION III

## DAM AND CANAL EXCAVATION, FOUNDATION PREPARATION, AND GROUTING

### 3-01. CLEARING AND GRUBBING.

(a) Clearing. - The entire work areas as shown on the contract drawing, sheet No. 2, shall be cleared as specified below.

(1) Canal, Foundation and Borrow Areas. - The canal area, foundation areas for the structures and embankments, and borrow areas shall be cleared of all trees, stumps, brush, fences, buildings, and any other objectionable material or structures.

(2) Spoil Areas. - In areas to be covered by spoil, trees shall be cut off at elevations not higher than 4 feet below the top of the spoil dump.

(3) Reservoir Areas. - Areas within the limits indicated on the drawing and below elevation 250, exclusive of those specified above, shall be cleared of trees, brush, fences, buildings, and any other objectionable materials or structures. All trees shall be cut off 2 feet above the ground surface except that no stumps shall remain above elevation 235. Where trees stand on ground between elevation 235 and 250 they shall be cut off flush with the ground.

(4) Other Areas. - Other areas not included in the above, within the work areas shown, shall be cleared only to the extent necessary for the contractor's camp, storage areas, shops, plant, and the conduct of the work.

(b) Grubbing. - Foundation areas for the embankments and borrow areas shall be grubbed of all stumps, perishable material, and roots greater than 1½ inches in diameter to a minimum depth of four feet below the original ground surface.

(c) Disposal. - All trees, stumps, roots, brush, fallen timber, buildings, and other debris cleared within the areas indicated above shall be burned, buried in spoil areas, or otherwise completely removed from the site to the satisfaction of the contracting officer. Disposal in the river of trees, stumps, roots, and other harmful material will not be permitted, and no material shall be piled in the stream bed, or on the river terrace, where it may be washed away by high water. The contractor shall be responsible for any damage done by fire, and shall at no time leave a fire unattended until it has been fully extinguished.

(d) Measurement and Payment. - No separate payment will be made for clearing and grubbing but the costs for such work shall be included in the contract price for other items of work.

3-02. CHARACTER OF MATERIALS TO BE EXCAVATED. - The location and logs of borings, test trenches, and test pits referred to in paragraph 1-18(a) made by the United States to determind the character of materials to be encountered and removed or to be used in the permanent structures are shown on the drawings or are available for inspection at the U. S. Engineer Office, Massena, New York. The United States does not guarantee that other materials will not be encountered nor that the proportions of the several materials will not vary from those indicated by the explorations.

### 3-03. CLASSIFICATION OF EXCAVATION.

(a) Rock Excavation. - All materials required to be excavated which, in the opinion of the contracting officer, cannot be removed by a 2½-cu.yd.

power shovel without continuous and systematic blasting, and all boulders and loose rock two cubic yards in volume or greater will be classed as rock excavation.

(b) Common Excavation. - All other material will be classified as common excavation, including boulders and loose rock less than two cubic yards in volume.

### 3-04. EXCAVATION REQUIREMENTS.

(a) Earth. - Excavation shall be carried to the lines, slopes, and grades shown on the drawings or as directed by the contracting officer. The specified areas shall be cleared and grubbed, and suitable topsoil may be stripped and stock-piled or placed directly in place over areas to be topsoiled, as specified in paragraph 4-08. Excavated earth shall be used in the required fills, or shall be placed in spoil areas shown on the drawings.

(b) Rock. - Rock shall be excavated to the lines and grades specified and/or shown on the drawings. All suitable rock excavated may be used by the contractor, or shall be placed in spoil areas shown on the drawings.

### 3-05. EXCAVATION FOR CONCRETE STRUCTURES.

(a) Removal. - Excavation for the concrete dam section shall be carried to a satisfactory firm foundation as determined by the contracting officer after completion of sub-surface explorations. Areas from which suitable earth materials may be obtained for embankments shall be stripped as directed by the contracting officer. The firm rock line shown on the drawings is only approximate and is not guaranteed. Should actual firm rock be encountered at a higher or lower elevation than the approximate firm rock line shown on the drawings, no change will be made therefor in the contract unit prices.

(c) Disposal. - All material excavated for the construction of the concrete structures which is suitable, as determined by the contracting officer, for the cofferdams, wing dams, and for backfill around the bulkhead sections may be placed directly in those features or in stock pile areas approved by the contracting officer. All other material not suitable or in excess of that required shall be disposed of in the spoil areas shown on the contract drawings in a manner and to an elevation satisfactory to the contracting officer.

### 3-06. EXCAVATION FOR EMBANKMENTS.

(a) Removal. - Embankment areas shall be stripped and excavated to lines and grades, and slopes as shown on the contract drawings or as directed by the contracting officer. The contractor shall de-water all excavation areas to produce a dry condition suitable for placing embankment as determined by the contracting officer. Should excavation be required to a higher or lower elevation than that indicated on the drawings, as determined by the contracting officer, no change will be made therefor in the contract unit prices.

(b) Disposal. -Material other than suitable topsoil, as determined by the contracting officer, excavated from foundation areas for the embankments (See paragraph 4-01) shall be placed in spoil areas shown on the plans or as approved by the contracting officer. Topsoil materials suitable for seeded areas shall be stock-piled or placed directly on the completed portions of the wing dams.

## 3-07. EXCAVATION IN BORROW PITS AND STOCKPILES.

(a) Borrow Pits. - The designated borrow areas to obtain embankment materials are indicated on the drawings (See paragraph 1-16). It is estimated that in the designated borrow areas and in the required excavation there is sufficient quantity of suitable material for the compacted fill sections of the embankments and cofferdams, but if, in the opinion of the contracting officer, additional borrow pits are required, they will be furnished without cost to the contractor. The contracting officer will specify the location at which borrow excavation will be made within the borrow areas. The specified areas shall be cleared and grubbed as stated in paragraph 3-01(b), and stripped to a depth of 18 inches or as otherwise directed by the contracting officer. The suitable topsoil from stripping may be stockpiled or placed directly in areas to be topsoiled as specified in paragraph 4-08. All other materials from stripping shall be finally disposed of in the excavated portions of the borrow areas. The depths of cuts and lifts and the disposition of the excavated materials may require the contractor to change the locations and depths of his excavating operations whenever such change is, in the opinion of the contracting officer, necessary to obtain the proper quality of material. The excavations shall be worked so that the materials are mixed in the process of excavation. Excavation within the borrow pits shall be in a manner to produce drainage of the material if the ground water table is above the elevation of the excavation. After the excavation is completed, excavated surfaces shall be graded to a smooth and pleasing appearance as directed by the contracting officer and each borrow area shall be so graded that the final surface area shall blend into the surrounding topography and all surface water will readily drain therefrom. (See also paragraph 1-16). The contractor shall construct and maintain all connecting roads required from the borrow areas to the place of disposal.

(b) Stockpiles.- Materials from stockpiles shall be obtained in a manner satisfactory to the contracting officer. The contractor will be required to excavate in the areas directed by the contracting officer and change the locations and depths of excavating operations wherever such a change is directed by the contracting officer. The final surfaces of the remaining part or parts of the stockpiles of earth fill shall be graded and blended into the surrounding topography satisfactory to the contracting officer. After the excavation from stockpiles of rock is completed, the remainder of the material shall be gathered and neatly piled as directed by the contracting officer.

## 3-08. POINT ROCKWAY CANAL.

(a) Excavation, General. - The contractor shall excavate the Point Rockway Canal within the limits and to the lines, slopes, and grades indicated on the drawings between stations 32 + 00 to 159 + 50. Excavation shall be carried to a bottom grade of elevation 213.0, except where solid rock is encountered the grade shall be lowered to elevation 210. The contractor may excavate by dredging or by land excavation methods, or by any combination thereof. Prior to commencement of work the contractor shall submit a plan satisfactory to the contracting officer indicating the equipment, methods, and procedure he proposes to use in excavating Point Rockway Canal, and shall thereafter keep the contracting officer informed of proposed operations, (See Paragraph 1-12).

(1) Dry Land Excavation. - Dry land excavation may be done by any method the contractor may select providing the excavated material is all

deposited within the areas designated as spoil areas in compliance with the provisions of disposal specified below.

(2) Dredging. - In areas where he elects to excavate by dredging, the contractor shall provide all channels, basins, dikes, pumping facilities, waste weirs, and other works required for placing his dredges on the site of the work. He shall create and maintain flotation pools of adequate depth, excavate and dispose of all materials as required herein, and remove his dredges from the site of the work. In connection with all dredging operations, he shall control his waste water so as to avoid damage to the activities of other contractors and to the public. Location, size, and type, of waste weirs shall be subject to the approval of the contracting officer. The cost of all such work shall be included in the contract unit prices for excavation. Where the specified side slopes intersect the ground surface at an elevation five feet or more above the dredge flotation pool, the prism of material lying above the pool and at the outer extremity of the slope shall be excavated by dry methods prior to dredging, as indicated on the drawings. Dredging of side slopes shall be conducted so as to produce minimum undercutting. The contracting officer will prescribe the maximum alowable depths of undercutting wherever he considers that the material being excavated is of such nature that slides extending beyond the limits of the specified side slopes might result from excessive undercutting.

(b) Disposal of Excavated Material. -

(1) The excavated material shall be disposed of adjacent to the canal as indicated on the drawings and the table below. If the contractor prefers to use other or additional spoil areas, he shall first secure the consent of the contracting officer in writing.

Disposal of Canal Excavation

| Station | Rock Excavation | Common Excavation |
|---|---|---|
| 32 + 00 - 70 + 00 | | South side |
| 70 + 00 - 80 + 00 | | In river |
| 80 + 00 - 100 + 00 | | South side |
| 100 + 00 - 121 + 00 | | Either or both sides |
| 121 + 00 - 159 + 50 | North side | South side |

The top of all spoil dumps shall be at elevation 233 or lower, or at elevation 249 or higher. Spoil dumps shall be built so that their front faces will present straight line contours parallel to the spoil control lines indicated on drawings. The spoil control line is a definite line shown on the plans and cross-sections for the purpose of establishing the position of the front slope at a definite elevation, thus making the front slope a plane surface. All dumps shall be leveled off on top and graded on the side and end slopes to give proper drainage and present an orderly and finished appearance. No dump shall be built with either its front, rear, or end slopes steeper than 1 vertical on 3 horizontal. The front slopes of dumps shall be kept as uniform as practicable. Gaps in spoil dikes for access to the canal and for drainage purposes shall be left at locations to give proper drainage of areas behind spoil piles.

(2) If the excavation is done by hydraulic pipeline dredges, the following provisions shall apply. All material dredged from the Point Rockway Canal shall be disposed of in accordance with the following provisions. Spoil areas are available for the disposal of material. All dredged materials must be deposited within the designated spoil areas unless specific authority for dumping in other areas is obtained in writing from the contracting officer. If, after the award of the contract, a dumping ground other than those stipulated in these specifications is proposed, its acceptance will be subject to the approval of the contracting officer. No hydraulic spoil area shall be left with any part of its top between the limiting elevations stipulated in

subparagraph (1) above. During the life of the contract, the contractor shall confine all dredged material to the designated spoil areas and shall be responsible for all damages which may ensue as a result of the escape of waste water or dredged material incident to his operations from any spoil areas whic he may utilize. Whenever practicable, all waste water originating from the operations of the contractor shall be conducted back into the excavation within the limits of his operations. The location of all temporary dikes and wast weirs shall be subject to the approval of the contracting officer. Where the material is deposited in confined areas, all embankments or bulkheads needed for confining or grading the material, with necessary waste weirs, must be provided and maintained by the contractor, and the cost thereof shall be included in the contract unit prices. In all pipeline dumps, the fill shall be so made as to be reasonably free from mounds, ridges, or depressions and the grade thereof shall be such as to avoid collecting points for water. The filling of any spoil area shall proceed continuously as far as possilbe. Under no circumstances, shall any dredged material be permitted to run or spread into the St. Lawrence River except in areas shown on the drawings. No natural water courses shall be obstructed without measures satisfactory to the contracting officer being taken by the contractor. The contractor shall provide any necessary drainage facilities to drain water pockets formed by his operatio

(c) Overdepth and Side Slopes. - To cover inaccuracies of the excavation work, materials actually removed within the specific areas to be excavated will be estimated to the limits specified below and paid for at the applicable contract prices.

Floor of Canal. - Common excavation to a depth of not more than one foot and rock excavation to a depth of not more than one and one-half feet below the required depth.

Side Slopes. - Common excavation to a depth of not more than one foot measured vertically, and rock excavation to a depth of not more than one foot measured horizontally outside the required side slopes.

Excessive overdepth and side slope excavation beyond the above limits will not be paid for and no payment will be made for material in excess of that originally lying above the excavation limits except as provided for under slides below.

(d) Slides. - Any slides occuring in a subsection of work prior to its acceptance shall be removed to the lines and grades directed by the contracting officer. If such slides occur through no fault of the contractor, the work of removal and disposal of slike materials will be paid for at the applicable contract unit prices for excavation. If the slides occur as a result of excessive undercutting of banks or any other fault of the contractor, as determined by the contracting officer, the slide materials shall be removed and disposed of without extra cost to the United States. If, before the contract is completed, slides occur in any subsection of work previously accepted, removal and disposal of the slide materials at the applicable contract unit prices for excavation may be done if agreeable to both the contractor and the contracting officer.

(e) Acceptance. -

(1) As soon as practicable after the completion of any portion of the canal which, in the opinion of the contracting officer, will not be subject to injury by further operations under the contract, such portion will b examined thoroughly by surveys, sounding, sweeping, or by a combination of thes methods, as deemed advisable by the contracting officer. Should any shoals, lumps, or other lack of required cross-section be disclosed by this examinatio the contractor will be required to remove them, at the applicable

contract rate for excavation, but if the bottom is soft and the shoal areas are small and form no material obstruction to navigation, the removal of such material may be waived, in the discretion of the contracting officer. The contractor or his authorized representative will be notified when surveys, soundings, and/or sweepings are to be made, and will be permitted to accompany the survey party. When the area is found to be in a satisfactory condition, it will be accepted finally. Should more than two sweeping operations by the United States over an area be necessitated by reason of work for the removal of shoals disclosed at a prior sweeping, the cost of such third and any subsequent sweeping operations will be charged against the contractor at the rate of $50.00 per day for each day or part thereof in which the United States sweeping plant is engaged in sweeping and/or is en route to or from the site or held at or near the said site for such operations.

(2) Final acceptance of the whole or a part of the work and the deductions or corrections of deductions made thereon will not be reopened after having once been made, except on evidence of collusion, fraud, or obvious error, and the acceptance of a completed section shall not change the time of payment of the retained percentages of the whole or any part of the work.

3-09. FOUNDATION PREPARATION - ROCK. - Foundation excavation for the concrete dam shall be carried to the lines and grades as indicated on the plans and/or to sound, firm ledge rock, free from open horizontal seams or disintegrated portions. Blasting against surfaces which will form the final surface will not be permitted, see paragraph 3-11. The foundation shall be prepared by barring, picking, wedging, or similar methods which will leave the rock of the foundation in an entirely sound and unshattered condition. The surface of the rock shall be left clean and rough to provide a proper bond between the rock and the concrete. All water shall be removed from the final foundation, which shall be moistened as required by the contracting officer prior to initial placement of grout. The contractor will be required to drill exploratory core holes as described in paragraph 3-13 in the foundation to determine the suitability of the bedrock. Payment for foundation preparation shall be included in the price bid for rock excavation.

3-10. LINE DRILLING. - The vertical rock faces for structures indicated on the drawings or as otherwise required by the contracting officer shall be made with a channeling machine, by drilling and broaching or by close line drilling. Rock excavation adjacent to channeled faces shall be removed in shallow lifts and short sections, and the channeled face remaining shall be of undisturbed rock.

3-11. BLASTING FOR EXCAVATION. - Blasting will be permitted only when proper precautions are taken for the protection of all persons, the work and property, and any damage done to the work or property by blasting shall be repaired by the contractor at his own expense. Caps or other exploders or fuses shall in no case be stored or kept in the same place in which dynamite or other explosives are stored. All operations of the contractor in connection with the transportation, storage, and use of explosives shall be subject to the approval of the contracting officer, and the contractor shall be liable for all injuries or deaths of persons or damage to property caused by blasting or explosives. All necessary precautions shall be taken to preserve the rock outside the lines of excavation in sound condition. Blasting may be done only to the depth, amount, and extent approved by the contracting officer. Approval of the method of blasting by the contracting officer, as specified in this subparagraph will not relieve the contractor of his responsibility in blasting operation, and no payment will be made for any rock required to be excavated outside of the limit lines indicated on the drawings or below the grade lines established in the field, or modifications thereof directed by the contracting officer, solely due to injury caused by the overshooting, improper blasting, or carelessness on the part of the contractor, and all rock thus removed shall be replaced by concrete at the expense of the contractor, including the payment for all cement used in such concrete and furnished by the United States. No blasting shall be done within one hundred (100) feet of concrete which has been in place less than seven (7) days.

## 3-12. DRILLING EXPLORATORY AND GROUT HOLES.

(a) General. - For the purpose of canvassing bids, the approximate extent of a tentative program for drilling exploratory and grout holes is outlined in these specifications. The Government reserves the right, however, to alter the location and depth of the exploratory and grout holes, and no change will be allowed in the contract unit prices because of such alteration. The contractor shall, at the proper contract unit prices, drill exploratory and grout holes at such locations and at such inclinations not to exceed twenty (20) degrees from the vertical, and to such depths, subject to the limitations hereinafter specified, as may be required by the contracting officer.

(b) Method of Rock Core Drilling. - Core drilling through rock shall be done with standard core drilling equipment using diamond or alloy bits designed to furnish complete standard cores a minimum of 2 inches in diameter from holes 3 inches in diameter. The contractor shall run his drills at such speeds as will insure satisfactory core recoveries, and the contracting officer may require, without compensation, the redrilling of those holes from which the cores are unsatisfactory if the contractor's operations are at fault.

## 3-13. EXPLORATORY CORE HOLES.

(a) General. - The foundation area covered by the concrete dam and areas adjacent thereto shall, after removing overburden, be further explored by rock core drilling as specified in paragraph 3-12. The layout of holes shall be as directed by the contracting officer. These holes in the foundation rock are intended to determine the location of suitable rock for the foundation of the concrete dam. Concreting shall not be commenced in any section until after the contractor has received written approval of the foundation for placing concrete for each monolith.

(b) Rock Cores. - Core boxes for storing the 2-inch cores, see paragraph 3-12 (b), shall be furnished at the site by the contractor. The cost of the boxes and spacers shall be included in the contract prices. All samples shall be in the custody of the contractor until transported from the site by a representative of the contracting officer, and while in his custody shall be protected. All boxes shall be of pine or similar soft lumber of lightweight, non-warping, and capable of holding screws without splitting. They shall be neatly and substantially constructed with suitable partitions, with the top of the box hinged and with suitable hasp fasteners. Partitions in the boxes shall run lengthwise, be securely fastened and shall be approximately 1/8-inch farther apart than the diameter of the rock core to be placed in the box. Spacers to separate the rock core obtained by each run shall be soft wooden blocks to fit between the core box partitions and 1½ inches in length. The core boxes shall be of uniform size 4 feet in length and approximately 12 inches in width, and shall meet with the approval of the contracting officer. All cores shall be neatly arranged in the sequence in which they are removed from the hole, and be properly identified.

(c) Filling with Grout. - All exploratory core holes shall be filled with grout consisting of sand and cement of such mixture as determined by the contracting officer. Sand for grouting shall be as specified in paragraph 3-14(e). The holes shall be filled with grout by a method satisfactory to the contracting officer.

## 3-14. PRESSURE GROUTING FOUNDATION.

(a) General. - The foundation rock shall be grouted at locations and to depths directed by the contracting officer. The necessity and extent of grouting is not known and the contractor will not be required to provide equipment for pressure grouting until he is so ordered by the contracting officer. The quantities shown in the bidding schedule for all items pertaining to grouting are given only for the purpose of canvassing bids and the Government does not guarantee that any of this work will be required or that the quantity will be limited to the amount estimated. If grouting is required, it shall be done in a manner satisfactory to the contracting officer by pressure grouting holes drilled after a minimum of 15 feet of concrete has been placed. The holes through the concrete may be obtained by percussion drilling or by placing 4-inch pipe prior to concreting. The core drilling shall be performed and 2-inch cores recovered as specified in paragraph 3-12. The contracting officer may require approximately 50 percent of the cores from grouting holes to be preserved and stored in core boxes. The core boxes shall be constructed and cores stored as specified in paragraph 3-13(b). Payment for core boxes in which cores from grouting holes are stored will be made as a separate item. The contractor will be required to protect the concrete surfaces during all drilling and grouting operations and no separate payment will be made for such protection. When the drilling of each hole has been completed, the hole shall be protected from being clogged or obstructed until it is grouted. Any hole that becomes clogged or obstructed prior to grouting shall be opened up to the satisfaction of the contracting officer, and no separate payment will be made therefor.

(b) Pressure Testing. - Before any hole is grouted it shall be pressure tested with water for leakage at intervals of 10 feet throughout the full depth of the hole. The contractor shall furnish the necessary equipment and make the tests. The equipment shall provide capacity sufficient to test the grout holes at pressure up to 150 pounds per square inch. A suitable gage shall be installed in the pressure line at the hole being tested so that pressures in the hole will be indicated at all times. A water meter reading directly to a 0.1 cubic foot per minute shall be installed in the pressure line to measure the leakage from the hole. The pressure shall be varied with the depth at the direction of the contracting officer. From the test results, the contractor shall furnish information indicating the location and amount of each leakage. Payment for pressure testing will be included in the contract unit price for "Drilling Foundation Grout Holes in Rock."

(c) Grouting Equipment to be Used. - The equipment to be used for mixing and injecting the grout shall be subject to the approval of the contracting officer. The grouting unit shall provide:

(1) A grout mixer for mixing the ingredients.

(2) A suitable water meter with straight-reading register reading to the nearest 0.1 cubic foot for measuring the mixing water.

(3) A water tank for auxiliary water supply to be used for pressure testing, flushing pumps, lines, and hole.

(4) A mechanically agitated sump to prevent the segregation of ingredients after mixing and to maintain a supply during the mixing period.

(5) Two duplex piston displacement grout pumps so piped and assembled as to provide interchangeable, continuous, and effective injection of grout at any desired pressure, not to exceed 250 pounds per square inch.

(d) Air compressors of suitable capacity, water pumps, and auxiliary equipment. The mixer and sumps shall each have a volume of not less than 15 cubic feet. The assembled unit shall allow the injection of 150 cubic feet of solids per hour at 150 pounds per square inch pressure, if desired. The grouting equipment shall be maintained in a manner satisfactory to the contracting officer and so as to insure continuous and effective performance during any grouting operation. Circulating grout lines shall be not less than 1½ inches in diameter and are to be controlled by suitable valves in the header and piping so that all or part of the grout can be injected into the hole, or all or part returned to the sump. A suitable pressure gage shall be provided at the hole as well as at the pump for indicating the pressure during the injection of grout. The pressure gage shall be installed in the header near the hole being grouted. By passing of the grout back to the sump tank shall be near the hole being grouted and not at the machine. Grout stops or packers and hole connections are to be provided which shall consist of a double sealing unit of 5 feet long. The expanding seals at each end shall be composed of rubber and have a length of 6 inches by 3 inches in diameter as directed by the contracting officer. Miscellaneous caulking tools and hammers and necessary labor for caulking will be furnished by the contractor as directed by the contracting officer.

(e) Composition of Grout and Method of Placement. - Grout shall consist of a mixture of neat Portland cement and water in proportions as directed by the contracting officer, or sand or rock flour may be mixed with grout in proportion not to exceed 1 cement to 3 sand or rock flour. The type and mixture of grout to be used will be determined by the nature of the seams to be grouted and as directed by the contracting officer. Sand, if used, will be of such fineness that 100 percent will pass a No. 28 standard sieve and 25 percent will pass a No. 100 standard sieve. Rock flour, if used, shall be dust obtained by crushing dolomite rock and it shall be at least as fine as specified above for sand. Cement for grouting will be furnished by the Government in paper bags (See paragraph 1-10(d)). Prior to pressure grouting, all grout holes shall be sounded and, if necessary, shall be thoroughly washed and cleaned with water under continuous pressure or by compressed air and water in a manner which will permit free overflow of waste water, by inserting a smaller pipe and introducing the wash water at the bottom of the hole. The speed of operation of the grout pump and the grouting pressure will be as directed by the contracting officer. In general, it is expected that pressures up to 150 pounds per square inch will be required for the deeper sections of the holes, while lower pressures will be used for the upper zones. Grouting shall be continued until the hole takes the grout mixture at a rate of less than one cubic foot in 10 minutes under the required grouting pressure, and the grouting of any hole will be discontinued when directed by the contracting officer. The contracting officer may require that the grouting of any holes may be temporarily suspended if work is proceeding in an unsatisfactory manner, and the hole protected by suitable means until grouting is resumed. In the event of an unavoidable delay during grout injection, the contractor shall supply water at not less than the specified grouting pressure for application to the hole as directed by the contracting officer. When the grouting of any hole has been commenced, it shall be continued until completion, unless otherwise directed by the contracting officer. After grouting operations for any hole have been completed and the grout set, or if the rock about any hole is in such sound condition that pressure grouting is not necessary, the hole shall be completely filled with grout. When a hole during the grouting procedure shows back pressure it shall be capped or otherwise sealed.

3-15. DRILLING 6-INCH CONCRETE CORES. - General. - The contractor shall drill holes in the concrete at such locations and to such depths as may be directed by the contracting officer in order to obtain concrete cores 6 inches in diameter in lengths satisfactory for testing. A tolerance of ½-inch permitted in the diameter of the cores. The contractor shall mark each core with black paint giving location and elevation. Upon completion of drilling, the contractor shall refill the hole with well-rodded concrete of the same mix and water content as that from which the core was taken.

3-16. MEASUREMENT AND PAYMENT.

(a) Measurement for Excavation. -

(1) Canal and Foundation Excavation. - A survey of the river bed and ground surface for canal and foundation excavation will be made prior to commencement of work and measurements of excavation will be based on this survey and on the classifications specified in paragraph 3-03. Measurement for common excavation will be made between the ground surface and the slope and grade lines shown on the drawings or as modified by the contracting officer, or to the natural rock surfaces encountered in such excavation.

(2) Borrow Areas and Stockpiles. - A survey of all borrow areas and earth stockpiles will be made prior to the removal of material. Measurement of excavation for embankment materials for payment will be based of this survey, and a final survey of the completed excavation.

(3) Rock Excavation. - Measurement for rock excavation will be made for the actual quantity excavated within the slope, structure, and grade lines shown on the drawings, or such modifications of these lines as directed by the contracting officer. No payment will be made for any rock excavation carried below or beyond these lines by unnecessary drilling and blasting and all rock thus removed in the dam foundation shall be replaced with concrete at the expense of the contractor.

(4) Slope Lines. - The excavation slope lines shown on the drawings for all work except the canal, do not represent actual slopes necessary and are not guaranteed by the Government as safe slopes for making the required excavations. The actual slopes required for safety shall be determined by the contracting officer and may be greater or less than shown.

(5) Point Rockway Canal. - The maps already prepared are believed to represent accurately average existing conditions but the topography at the site of the work will be verified and corrected by surveys made prior to commencement of work in each area. When necessary for any cause to convert "scow measurement" into "place measurement," or the reverse, ten yards of the former will be taken as the equivalent of nine yards of the latter.

(b) Payment for Excavation.-

(1) Foundations. - The price bid for foundation excavation shall include the cost of clearing and grubbing, stripping, transporting and disposal as required under paragraphs 3-01, 3-05, and 3-06. Payment will be made at the respective and contract unit prices per cubic yard for "Excavation; Common, Dam," and "Excavation; Rock, Dam."

(2) Borrow. - Payment for all earth embankment materials excavated from the borrow pits including material stripped from the surface will be made at the contract unit price per cubic yard for "Excavation, Borrow," which unit price shall include all costs of draining, excavating, transporting, and dumping the suitable fill material in the embankments; and the stockpiling and disposal of the stripping material, and the cost of all operations attendant thereto.

(3) Stockpiles. -

a. Earth. - Where stockpiling of suitable common excavation material prior to its incorporation in fill is directed by the contracting officer, separate payment will also be made for excavating from these stockpiles at the rate of 50 per centum of the contract unit price for "Excavation; Common, Dam"; provided, however, that no payment will be made for stockpiling when and where the contractor is offered the alternative of suspending excavation but elects to stockpile in lieu of suspension. The alternative of suspending excavation will be offered only when and to the extent that in the opinion of the contracting officer progress has been such as to warrant it. Such offer shall not constitute a basis for extension of time limit under the contract. No separate payment will be made for excavating topsoil from stockpiles, see paragraph 4-08.

b. Rock. - No separate payment will be made for rock excavation from stockpiles, see paragraph 4-07 (c).

(4) Point Rockway Canal. - The price bid for canal excavation shall include the cost of clearing, transporting, disposal, and all operations in connection therewith as specified under paragraph 3-08. Payment will be made at the respective contract unit prices per cubic yard for "Excavation; Common, Canal," and "Excavation; Common, Rock." The contract unit prices for canal excavation shall also include the cost of any necessary excavation, embankment construction, or other work required to lock or float a dredge to or from the site of the work. The location and dimensions of any cut embankments or other works so made will be subject to the approval of the contracting officer. (See subparagraph 3-08 (b) (2)). Monthly partial payments will be based on approximate quantities determined by surveys, soundings, or sweepings made after excavation operations, see paragraph 3-08 (e).

(c) Line Drilling. - Measurement for line drilling will be made along the vertical surfaces indicated on the drawings or established by the contracting officer. Payment for channeling, drilling and broaching, or close line drilling will be made at the contract unit price per square foot of vertical surface for "Line Drilling."

(d) Exploratory Core Holes. - All measurements for payment shall be made by or in the presence of an authorized representative of the contracting officer. Holes will be measured for payment for the number of linear feet drilled from the rock surface to the bottom of the hole as specified under paragraph 3-13. Payment will be made at the contract unit price per linear foot for "Drilling 3-inch Exploratory Holes," which payment shall include all work in connection with drilling, core recovery, core boxes, and storage at the site, and for mixing and placing the grout filling. Cement will be furnished by the Government and the sand will be paid for at the contract unit price per cubic foot for "Sand in Grout."

(e) Drilling 6-Inch Concrete Cores. - Payment for drilling 6-inch concrete cores and for refilling holes with concrete as specified under paragraph 3-15, will be made at the contract unit price per linear foot for "Drilling 6-inch Concrete Cores," for actual core lengths drilled and recovered. The quantity shown in the bidding schedule for "Drilling 6-inch Concrete Cores" is given only for the purpose of canvassing bids and the Government does not guarantee that any of this work will be required or that the quantity will be limited to the amount estimated.

(f) Grouting- Drilling and Placing. -

(1) Drilling. - Measurement for payment of holes in concrete will be from the plane of entry of the drill at the concrete surface to the bottom of the concrete. Measurement for payment for holes in rock will be from the plane of entry of the drill at the rock surface to bottom of hole. Payment for drilling grout holes in concrete and rock will be made at the contract unit price per linear foot for "Drilling Foundation Grout Holes in Concrete" and "Drilling Foundation Grout Holes In Rock" respectively, which payment shall include, as specified under paragraph 3-14, drilling, pressure testing, protection of the completed hole, and all costs in connection therewith. If the contractor uses 4-inch pipe for the holes through concrete in lieu of drilling he will be paid for such holes as are authorized to be used at the same rate as though the holes were drilled.

(2) Core Boxes that may be required to store cores from grout holes will be paid for at the contract unit price each for "Core Boxes", which payment shall include all costs for transporting and storage in connection therewith.

(3) Providing Pressure Grouting Equipment. - Compensation for providing pressure grouting equipment as specified in paragraph 3-14 will be made if such equipment is provided at the site upon the order of the contracting officer. Payment of this item will be made at the contract lump sum price for "Providing Pressure Grouting Equipment."

(4) Payment for grouting will be made at the contract unit price per cubic foot for "Pressure Grouting." The volume of grout will be considered to be equal to the volume of cement and sand or rock flour used. This payment shall include washing and jetting of grout holes, and all materials, equipment, and labor necessary, except that cement will be furnished by the United States. No payment will be made for grout lost due to improper anchorage of grout pipes or connections, nor for grout rejected by contracting officer because of the improper mixing.

(5) Payment for furnishing sand or rock flour used in grouting will be made at the contract unit price per cubic foot for "Sand in Grout" or "Rock Flour in Grout."

## SECTION IV

## EMBANKMENTS, BACKFILL, AND PROTECTION STONE

4-01. DEFINITION. - The term "Embankments" as used in this section includes the compacted earth fill of the wing dams; the compacted earth backfill around the bulkhead sections of the concrete dam; the sand and gravel backing and riprap protection of the abutment slopes and wing dams; and the random rock backfill downstream from the spillway.

4-02. GENERAL PROVISIONS.

(a) Lines and Grades. - The embankments shall be constructed to the lines and grades shown on the drawings or otherwise required by the contracting officer. The contracting officer reserves the right to change the foundation widths, change the slopes and dimensions of the embankments, change the dimensions and slopes of the foundation cut-off trenches and change the shape and thickness of the dumped riprap protection and make such other changes as future studies and conditions on the work indicate as necessary for the construction of a safe and permanent structure as determined by the contracting officer. Changes in quantities of materials resulting from changes in sections shall be no cause for claims of increased contract unit prices.

(b) Materials. - Materials for the various sections of the embankments shall conform to the respective requirements specified in the following paragraphs of this section. No brush, roots, sod, and perishable or objectionable materials, as determined by the contracting officer, shall be placed in the embankments. Any objectionable material placed in the embankments shall be removed by the contractor as directed by the contracting officer, without cost to the Government. The suitability of each part of the foundation for placing embankment materials thereon and of all materials for use in an embankment will be determined by the contracting officer. No materials shall be placed in an embankment when either the materials or the foundation on which they are to be placed is frozen.

(c) Conduct of the Work. - The contractor shall at all times maintain the embankments in conformity with paragraph 4-04(c) and in a manner satisfactory to the contracting officer until the final completion and acceptance of all work under the contract. The contractor may be required to suspend work at any time when, in the opinion of the contracting officer, satisfactory work cannot be done on account of rain, floods, cold weather, or other unsatisfactory conditions. Any approved embankment material which is lost or rendered unsuitable after being placed in an embankment and before the completion and final acceptance of the work, due to causes that, in the opinion of the contracting officer, are avoidable, or under the control of the contractor, shall be replaced by the contractor in a manner satisfactory to the contracting officer and without cost to the Government. The contracting officer may require the contractor to remove without cost to the Government any material placed by the contractor outside of specified slope lines.

(d) Order of Work. - The contractor shall be required to organize the work so that suitable rock and earth fill materials obtained from the excavations for the construction of concrete structures may be placed directly in the portions of the wing dams between the ends on the natural ground and points 150 feet from the top of the excavation slopes for bulkhead sections. After the bulkhead sections are constructed, the backfilling and abutment embankments shall be completed.

4-03. PREPARATION OF FOUNDATION FOR EMBANKMENT.

(a) General. - The foundations for the embankments shall be stripped and excavated as specified in Section III. The test pits, stump holes and other excavated areas, depressions and cavities within the limits of the embankment shall be filled with compacted earth as directed by the contracting officer. The earth fill shall be placed in layers, moistened and compacted in accordance with paragraph 4-04. As the fill is brought up, the side slope of the cut or hole shall be scarified, if in the opinion of the contracting officer, it is required, in order to provide a bond between the fill and the original ground material. The sides of all holes shall be broken down if necessary so as to flatten out the slopes, and the hole then filled with approved material and properly rolled or tamped in place. Immediately prior to placing materials in the wing dams, the entire foundation, except areas to be covered by sand and gravel filter, shall be scarified to a depth of 4 inches. A 4-inch layer of embankment material shall be spread and compacted as specified for Class I fill in paragraph 4-04(e). The foundation upon which fill is placed shall be in a suitable dry condition, as determined by the contracting officer.

(b) Measurement and Payment. - Payment for the fills in the foundation areas indicated above, including the spreading, rolling and wetting where required will be made at the contract unit price per cubic yard for "Earth Fill; Compacted". No payment as a separate item will be made for other work necessary for the preparation of the foundation including the dewatering in the foundation areas of the embankments, but the cost of these items shall be included in the contract unit prices for the other items of work connected with the embankments.

4-04. COMPACTED EARTH FILL.

(a) General. - The earth sections of the embankments shall be constructed of Class I and Class II compacted fill as shown on the drawings. The center section of the wing dams shall be composed of Class I compacted fill, rolled and compacted as specified in paragraph 4-04(e) below. Upstream and downstream sections of the wing dams shall be composed of Class II compacted fill and shall receive such rolling by the hauling and spreading equipment as is specified in paragraph 4-04(e). Backfill within 50 feet of the bulkheads shall be composed of Class I compacted fill, and beyond 50 feet shall be Class II compacted fill.

(b) Material for the earth fill sections of the embankments including backfill around the bulkhead sections of the dam shall be secured from the designated borrow areas and from the excavations for the construction of the dam or canal. The materials for both Class I and Class II compacted fill in general will be a well graded clayey or silty sand and gravel. No stones which would be retained on a 6-inch screen will be permitted in the Class I compacted earth fill. No stones which would be retained on an 8-inch screen will be permitted in the Class II compacted earth fill. Should stones of such size be found in the otherwise approved earth fill embankment materials, they shall be removed by the contractor. Suitable stones removed may be used for riprap as specified in paragraph 4-07. Each load of material to be placed in the compacted earth fill shall be the equivalent, as nearly as practicable, of a mixture of materials obtained from an approximately uniform strip or cutting from the full height of a lift in excavation. The combined excavation and embankment placing operations shall be such that the materials when compacted in the fill will be blended sufficiently to secure the greatest homogeneity and desired density.

Any material encountered in the required excavation that meets the requirements of paragraphs 4-05 may be used for sand and gravel backing as directed. Additional materials required for sand and gravel backing not obtainable from required excavation shall be obtained from other sources by the contractor.

(c) Placement. - The distribution and gradation of materials throughout the earth fill sections of the embankments shall be such that the embankments will be free from lenses, pockets, streaks or layers of materials differing materially in texture or gradation from the surrounding material. The dumping of successive loads of earth fill materials from the different parts of the borrow pits, stock piles or required excavations shall be at locations in the embankment as directed by the contracting officer, and for this purpose, the contracting officer may direct the points in the embankments where individual loads of material shall be deposited, to the end that the more pervious material shall be placed in the downstream section of the wing dams and in the outer sections of the backfill. After dumping, the materials shall be spread by bulldozers or other approved methods in approximately 8-inch layers over the prepared foundation or fill. Materials within 18 inches of concrete walls and in other areas where compacting by rolling is impracticable as determined by the contracting officer, shall be spread in layers 4 inches in thickness before compacting. All layers shall extend at an approximately uniform elevation over the entire width of the cross section of the embankment and for the entire length of the section under construction unless otherwise directed by the contracting officer. The top surfaces of the earth fill sections of the embankments during construction shall be kept crowned with grades not less than 2 nor more than 4 percent, so that the surface of the fill will drain freely toward the slopes. The surface of the fill shall be maintained at all times in such a manner that no water pockets will be formed under any weather conditions. If work is stopped on any part of the Class I compacted earth fill or backfill for a period of time, the area to remain standing shall be rolled with a smooth-faced roller to prevent loss of moisture and to facilitate drainage. If, in the opinion of the contracting officer, the rolled surface of any layer of any section is too smooth to bond properly with the succeeding layer or adjacent section, it shall be roughened or loosened by scarifying to the satisfaction of the contracting officer before the succeeding layer is placed thereon. Ruts in the surface of any layer shall be filled in a manner satisfactory to the contracting officer.

(d) Moisture Control.

(1) The material in each layer of fill while being compacted shall contain moisture within a few percent of the optimum, as determined by the con racting officer, for the compaction desired. Prior to and during construction, the contracting officer will establish the limiting ranges of moisture contents for materials to be compacted in Class I fill and Class II fill. The moistre content shall be uniform throughout the layer. If the application if water is necessary, it may be done either at the borrow area or at the embankment. Wetting at the excavation area shall be supplemented as required by sprinkling in place on the embankment, if in the opinion of the contracting officer it is necessary. The contractor shall maintain adequate facilities to provide the amount of water required.

(2) No layer of material shall be placed if the moisture content of the exposed surface on which it is to be placed is not within the range established by the contracting officer. The contractor shall correct the moisture content of the compacted layer if the moisture content is not within the required limits.

(e) Compaction. - Class I fill and Class II fill shall be rolled and compacted with the equipment listed in paragraph (f) below. Each layer of Class I fill shall be compacted by not less than 6 passes or trips and each layer of Class II fill shall be compacted by not less than 2 passes or trips of a sheepsfoot roller. In areas within 18 inches of concrete walls and other areas where rolling operations are impracticable, as determined by the contracting officer, compaction shall be obtained with power tampers of a type approved by the contracting officer to give compaction equal to that required for the adjoining compacted earth fill. Each pass of a roller shall overlap the adjacent rolled area by at least 2 feet. If the moisture content is greater or less than that required for compaction, the rolling or tamping shall be delayed until the proper moisture content as determined by the contracting officer has been reached.

(f) Equipment for Compaction by Rolling. - Equipment consisting of an oscillating double section sheepsfoot tamper roller, pulled by a crawler type tractor weighing not less than 20,000 pounds and which is weighted or equipped with a bulldozer, or both, to increase its total weight to not less than 29,000 pounds, shall be used for compacting Class I fill. The use of more than 2 rollers in tandem will not be permitted. The design and operation of the compacting equipment shall be subject to the approval of the contracting officer. The speed of the compacting equipment shall be not more than 2½ miles per hour. Each drum of the oscillating double section sheepsfoot tamper roller shall be approximately 4 feet in width and shall have tamping feet uniformly staggered over its cylindrical surface and be provided with cleaners. Each tamping foot shall project approximately 7 inches from the roller's cylindrical surface and at no time during operation shall have a face area less than 5 nor more than 7 square inches. The spacing shall be such as to provide not less than 1½ tamping feet for each square foot of cylindrical surface. The sheepsfoot roller shall be weighted so that the total weight of the roller and ballast in pounds divided by the total areas of the maximum number of tamping feet in one row generally parallel to the axis of the roller shall provide for a range of 250 to 400 pounds per square inch by varying the roller ballast.

(g) Tests for Compaction. - Samples for testing of all materials in the embankments, both before and after placement and compaction, will be taken by the contracting officer at frequent intervals. Corrections, adjustments, and modifications of methods may be required as the result of these tests, for materials, moisture content, or additional compaction of the materials, in the embankment. In taking samples for control and record purposes, the contractor shall supply labor required to assist the inspector, as directed by the contracting officer. During the construction of the embankments, it may be necessary for the contractor as directed by the contracting officer to construct test embankments which will form part of the completed fill to determine the number of passes or moisture content necessary to obtain the desired compaction.

(h) Additional Compaction. - If the tests specified above indicate that the desired compaction of the materials in the compacted earth fill sections of the embankments is not secured by the compaction specified in paragraph 4-04(e), additional compaction may be required by the contracting officer. Additional compaction shall consist of making not less than 2 passes of a sheepsfoot roller specified in paragraph 4-04(f) over such designated areas. Each pass of a roller shall overlap the adjacent rolled area by at least 2 feet. This procedure will be repeated as often as is necessary to obtain the desired compaction.

(i) Measurement and Payment.

(1) Measurement for compacted earth fill placed in embankments will be made between the lines indicated on the drawings and the required stripping or excavation lines. Payment for Class I and Class II compacted earth fill will be made at the contract unit price per cubic yard for "Earth Fill; Compacted", which payment shall include all incidental work specified or required such as transporting and spreading, mixing, scarifying, harrowing, moistening, drying, compacting, removing oversize stones and objectionable materials.

(2) Payment for each additional two passes of a roller as required by the contracting officer will be made at the contract unit price per square (100 sq. ft.) for "Additional Compaction".

### 4-05. SAND AND GRAVEL BACKING.

(a) General - Sand and gravel backing for riprap on slopes shall be constructed to the lines and grades shown on the drawings. During construction the placing shall be kept at substantially the same level as the compacted earth fill.

(b) Material. - Material for sand and gravel backing shall consist of bank run sand and gravel of which the material after placement shall contain from 30 to 60 percent by weight retained on the ¼-inch mesh screen, and no stones shall be larger than 6 inches. Of the material passing the ¼-inch mesh screen, not more than 20 percent shall pass the No. 200 mesh screen. Samples of proposed material shall be submitted to the contracting officer at least 30 days prior to the date that the contractor plans to commence placement.

(c) Measurement and Payment. - Measurement of sand and gravel backing material will be made between the lines indicated on the drawings, or as modified by the contracting officer. Payment for furnishing and installing backing material, regardless of source, (see Paragraph 1-16) will be made at the contract unit price per cubic yard for "Sand and Gravel Backing".

### 4-06. RANDOM ROCK FILL.

(a) Classification. - The excavated area downstream from the spillway shall be backfilled as shown on the drawings with rocks of random sizes. At least 95 % of the rock shall be sound, and durable, and as approved by the contracting officer. It shall be obtained from the required rock excavation. Eighty per cent of the random rock fill in the upper three feet shall be pieces weighing 400 pounds or more. The remainder of all the rock shall be pieces weighing more than 200 pounds.

(b) Measurement and Payment. - The quantity to be paid for under this item shall be the number of cubic yards of random rock fill measured in place in the fill as determined from surveys made before and after placement. The price bid shall cover the furnishing and placing the material and all incidental expenses thereto. Payment will be made at the contract unit price per cubic yard for "Rock Fill; Random".

4-07. RIPRAP.

(a) Classification. - All rock for the riprap protection of the embankments shall be clean, sound, and durable, and as approved by the contracting officer. It shall be obtained from the required rock excavation and earth fill material. Shale and other rock which in the opinion of the contracting officer will not endure frost action shall not be used. Riprap shall be composed of the following two classes of material:

(1) Class A. - Eighty percent of the Class A riprap shall be pieces weighing over 500 pounds and the remainder shall vary with fair uniformity to a minimum weight of 200 pounds. The least dimension of any stone shall be not less than one-third its greatest dimension.

(2) Class B. - This riprap shall consist of rocks weighing in general not over 250 pounds, of which not more than 10 % of the whole shall be formed of pieces weighing less than 15 pounds which shall be well distributed throughout the mass.

(b) Placement. - Riprap shall be dumped in the sections to the line and grades shown on the drawings or as directed by the contracting officer. The different sizes of each class shall be well distributed within the section. Care shall be taken in dumping and placing not to disturb the underlying fill. The dumped riprap on the slopes of the wing dams and on the slopes of the abutments may be placed any time during the construction of the embankments providing that, the level of the riprap shall not exceed the level of the compacted earth fill section; any change in the slopes of the compacted earth fill including slides and washout shall be repaired by the contractor as directed by the contracting officer at no cost to the Government. In the areas where Class B dumped riprap will form the final surface, such hand placing of the finished rock surface will be required as will insure a reasonably smooth and continuous surface to the slope lines shown on the drawings or as modified by the contracting officer with a tolerance not exceeding plus or minus 9 inches. At the end of a working season for placing compacted earth fill, the dumped riprap sections shall be complete.

(c) Measurement and Payment. - Measurement for riprap in the dumped riprap sections will be made in the embankments between slope lines and grade lines shown on the drawings or as modified by the contracting officer. Payment for the two classes of riprap will be made at the contract unit prices per cubic yard for "Riprap, Dumped; Class A", and "Riprap, Dumped; ClassB", which will include payment for excavation from stockpiles, the selection of materials, cleaning, hauling, placing, and all other work required for the completion of the riprap sections in accordance with these specifications.

4-08. SEEDING AND SEEDED TOPSOIL.

(a) Preparation of Seed Bed. - The areas indicated on the drawings or required by the contracting officer shall be covered with topsoil. All other areas to be seeded but not requiring topsoil as directed by the contracting officer shall, prior to fertilizing and seeding, be harrowed or raked until the soil has become loosened and pulverized. All sticks, litter, roots, weeds, stones larger than 1 inch in diameter, and other objectionable materials shall be removed to a depth of 2 inches. Areas requiring topsoil shall be covered with topsoil to a depth of not less than 4 inches after compaction. The topsoil shall be compacted by an approved method. The surface of all seed areas shall be trimmed and raked to conform to finished grades, after which the soil shall be fertilized as specified below. Immediately before sowing the seed, the surface of the seed bed shall be sprinkled, if necessary, and raked to a depth of 3/4 of an inch. The raking shall be done in a direction parallel to the contour lines of the slopes (not uphill or downhill).

(1) Topsoil. - Topsoil shall be furnished by the contractor from areas approved by the contracting officer (see paragraphs 3-07(a) and 3-06(b). Topsoil shall be good, rich, dark loam, free from subsoil, gravel, unbroken sod, roots, and refuse. Acceptable topsoil shall be a mixture of sand, silt, and clay particles, and shall contain not less than 5 % organic matter as determined by loss on ignition of oven dried samples.

(2) Method of Fertilizing. - Prior to seeding, fertilizers shall be uniformly spread in a manner satisfactory to the contracting officer. The seed beds consisting of topsoil shall be fertilized with 1,000 pounds of 20% superphosphate and 300 pounds of sulphate of ammonia to the acre. The seed beds in areas not covered with topsoil shall be fertilized with 1,000 pounds of 20% superphosphate and 200 pounds of sulphate of ammonia to the acre. In place of the superphosphate, 330 pounds of T.V.A. metaphosphate to the acre may be used.

(b) Seeding. - The quantity and types of seeds specified below shall be sown on prepared seed beds in a manner satisfactory to the contracting officer. The mixtures shall be sown at the earliest date possible between May 1 and October 1 on areas covered with topsoil, and between May 1 and September 1 on areas not covered with topsoil. The seed mixtures shall be sown by a mechanical hand seeder or drill. Whenever practical, the mixtures shall be sown in two applications, one-half the seed while the sower is travelling in one direction, and the other half sown while travelling at right angles to the first. The oats or rye shall be sown separately from the remainder of the seed mixture. The domestic rye grass may be sown either separately or mixed with the other seeds. If oats or rye is sown on the surface, the seeds shall be covered by raking to a depth from 1 to 1½ inches. After all the seed is sown, the seed bed shall be lightly raked with iron rakes, and then rolled with a lawn roller in a manner satisfactory to the contracting officer.

(1) Seed Mixtures. - The seed mixtures shall consist of the seeds specified in the tables below. When directed by the contracting officer, the seed mixtures may be varied to suit special conditions of soil peculiar to the areas to be seeded. The seed furnished shall be of the previous year's crop and in no case shall the weed content exceed 1% by weight.

Seed Mixture for Seed Bed of Topsoil

| Kind of Seed | % Purity | % Germination | Amount lbs. per acre |
|---|---|---|---|
| Kentucky Blue Grass | 98 | 88 | 20.0 |
| Creeping Red or Chewing Fescue | 97 | 70 | 15.0 |
| Canadian Blue Grass | 93 | 85 | 10.0 |
| Domestic Rye Grass | 98 | 90 | 10.0 |
| Red Top | 90 | 90 | 7.5 |
| Kent Wild Clover | 97 | 90 | 2.0 |
| Ladino Clover | 97 | 90 | 2.0 |
| Alsike | 97 | 90 | 3.5 |
|  |  |  | 70.- |

### Seed Mixture for Seed Bed Not Containing Topsoil

| Kind of Seed | % Purity | % Germination | Amount lbs. per acre |
|---|---|---|---|
| Sweet Clover | 99 | 85 | 5 |
| Alfalfa | 98 | 85 | 2 |
| Black Medic | 95 | 80 | 1 |
| Orchard Grass | 97 | 90 | 3 |
| Timothy | 98 | 85 | 3 |
| Red Top | 98 | 90 | 4 |
| Ladino Clover | 97 | 90 | 1 |
| | | | 19 |
| Oats (Seeding prior to July 15) | 99 | 90 | 30 |
| Rye (Seeding after July 15) | 99 | 90 | 35 |

(2) Inoculation. - The alfalfa, Black Medic, Alsike, Sweet Clover, Kent Wild Clover, and Ladino Clover seeds shall be inoculated with pure cultures of nitrogen fixing bacteria. Inoculants shall consist of pure bred soil or sand cultures, not more than one year old, and shall meet the approval of the New York State Department of Agriculture and Markets. The inoculants shall be mixed with the seed according the the vendor's instructions. After the mixture is dried, it shall be mixed with the grass seeds. All mixing, drying, and storing shall be done in the shade. The seed mixture shall be applied to the seed bed within 72 hours after the legume seeds are inoculated.

(c) Maintenance and Reseeding. - The contractor shall maintain the areas sown with the above seed mixtures until all work on the contract has been completed and accepted by the contracting officer. The maintenance shall consist of refilling rain-washed gullies, reseeding, mowing, watering during periods of drought, removing in topsoiled areas of large and conspicuous weeds, and other similar operations when required by the contracting officer. The contractor may, if he desires, protect slopes against erosion until seeding becomes established by spreading on the surface about four tons of straw to the acre.

(d) Measurement and Payment. - Measurement for seeding and seeded topsoil will be made by the acre for the area within the line shown on the drawings or as modified by the contracting officer. The contract unit prices shall include payment for all work in connection with furnishing and sowing all necessary seed, raking and rolling the seeded areas, preparing the seed beds, furnishing and placing all necessary fertilizer, and maintaining all seeded areas. Payment for all work in connection with preparing and seeding the seed bed of topsoil, including furnishing, stockpiling, rehandling, transporting, placing, spreading, rolling, and finishing the topsoil, will be made at the contract unit price per acre for "Seeded Topsoil". Payment for seeding all seed beds not of topsoil will be made at the contract unit price per acre for "Seeding".

## SECTION V - CONCRETE

5-01. COMPOSITION. - Concrete shall be composed of cement, fine aggregate, coarse aggregate and water so proportioned and mixed as to produce a durable, plastic, workable mixture in accordance with all requirements under this section and suitable to the specific conditions of placement.

5-02. CLASSIFICATION.

(a) Designation. - Except where required to meet special conditions, all concrete shall be Class "A", Class "B", or Class "C" in accordance with the conditions of application and the proportions of materials and strengths required.

(b) Class "A" concrete shall be used for the pier houses, roadway bridge floor, bulkhead slabs and interior walls, and as otherwise indicated on the drawings or directed by the contracting officer.

(c) Class "B" concrete shall be used in the bridge piers, exterior walls of the bulkheads, and as otherwise directed by the contracting officer. In general Class "B" concrete shall be used in all reinforced portions of the structure not specifically designated as Class "A" or Class "C" concrete.

(d) Class "C" concrete shall be used for the mass section of the dam.

5-03. STRENGTH. - Test specimens of concrete (see paragraph 5-10) will be 6" x 12" or 8" x 16" cylinders. Samples will be wet-screened to remove aggregate greater than one-fourth the diameter of the test specimen. The mixes will be designed to secure concrete having at least the following compressive strengths at the age of 28 days:

| Class | Average for any 25 Consecutive cylinders | Minimum for any one cylinder |
|---|---|---|
| A | 3400 lbs. per sq. in. | 2600 lbs. per sq. in. |
| B | 3000 lbs. per sq. in. | 2200 lbs. per sq. in. |
| C | 2400 lbs. per sq. in. | 1600 lbs. per sq. in. |

5-04. HIGH-EARLY-STRENGTH CONCRETE. - High-early-strength concrete made with high-early-strength Porland cement or other special cements, shall be used only when specifically authorized by the contracting officer. The 7-day compressive strength of concrete of any class, when made with high-early-strength cement, shall be at least equal to the specified minimum 28-day compressive strength for that class using standard cement. All provisions of these specifications, except for cement, shall be applicable to such concrete.

5-05. CEMENT AND AGGREGATES.

(a) Cement will be furnished to the contractor by the Government in accordance with paragraph 1-10 of these specifications.

(b) Fine aggregate shall be furnished by the contractor and may be either natural sand or crushed stone sand. (See Article 17 of Invitation for Bids.) Sufficient material may be obtained for crushed stone sand from the canal excavation. Coarse aggregate shall also be furnished by the contractor and may be secured by crushing rock obtained from the canal excavation.

## 5-06. FINE AGGREGATE.

(a) Composition. - Fine aggregate shall be natural sand, or manufactured sand. If crushed stone sand is furnished for the fine aggregate it shall be manufactured from material which has been crushed to pass the 3" square mesh screen and be retained on a 1/2" square mesh screen. Tailings from this preliminary crushing and screening will not be accepted. Only clean dense, tough, durable dolomite stone will be acceptable for artificial sand manufacture.

(b) Quality. - Fine aggregate shall consist of hard, strong, durable and uncoated particles.

(c) Grading.

(1) The fine aggregate shall be well graded from coarse to fine and when tested by means of U. S. Standard square mesh sieves shall fall within the following limits of gradation:

| | Percent Passing, by Weight | |
|---|---|---|
| Sieve Size | Natural Sand | Manufactured Sand |
| 3/8" | 100 | 100 |
| No. 4 | 95-100 | 95-100 |
| 8 | 75- 90 | 80- 95 |
| 16 | 50- 75 | 55- 80 |
| 30 | 30- 55 | 30- 60 |
| 50 | 12½-25 | 15- 30 |
| 100 | 3.5- 8 | 5- 12 |

(2) If natural sand is furnished the fineness modulus shall be not less than 2.50 nor more than 3.00; if manufactured sand is furnished the fineness modulus shall be not less than 2.40 nor more than 2.90; and in either case the fineness modulus of the sand shall not very more than 0.20 from lowest to highest.

(3) Deficiencies in the quantities passing the #50 and #100 sieves may be compensated for by furnishing, through separate shipment and at the contractors expense, a sufficient quantity of fine dune sand of approved quality and grading. This quantity shall not exceed 15 percent by weight of the total fine aggregate.

(d) Deleterious Substances. - The substances designated shall not be present in excess of the following amounts:

| | Percent by Weight |
|---|---|
| Clay lumps - - - - - - - - - - - - - - | 1 |
| Material removed by decantation from aggregates not more than - - - | 3 |
| Shale - - - - - - - - - - - - - - - - - | 1 |

(e) Mortar Strength. - Mortar specimens made with the fine aggregate shall have a compressive strength at 28 days of at least 90 percent of strength of similar specimens made with Ottawa sand having a fineness modulus of 2.40±0.10 and the same cement.

(f) Tests. - Fine aggregates will be subjected to the following tests:

(1) Freezing and thawing test performed in accordance with

A.S.T.M. Specification C137 - 39T, "Soundness of Aggregates by Freezing and Thawing," shall not show a loss in 25 cycles of more than 5 percent, or not more than that shown by sand of proven quality.

(2) Magnesium sulphate accelerated soundness test performed in accordance with A.S.T.M. Specification C88 - 39T, "Soundness of Aggregates by use of Sodium Sulphate or Magnesium Sulphate," shall not show a loss in 10 cycles of more than 10 percent.

## 5-07. COARSE AGGREGATE.

(a) Composition. - Coarse aggregate shall be washed gravel or crushed stone.

(b) Quality. - Coarse aggregate shall consist of hard, tough and durable particles free from adherent coating. It shall contain no vegetable matter nor soft, friable, thin or elongated particles in quantities considered deleterious by the contracting officer. Aggregate which has disintegrated or weathered badly under exposure conditions similar to those which will be encountered by the work under consideration, shall not be used. The substances designated below shall not be present in excess of the following amounts:

Soft particles (including shale) - - - - 5%
Clay lumps - - - - - - - - - - - - - - - - 0.25%
Removed by decantation - - - - - - - - - - 1%
Thin or elongated particles- - - - - - - 10%

When the material removed by decantation consists essentially of crusher dirt the maximum amount permitted may be raised to 1-1/2 percent. When crushed stone is used the crusher shall be equipped with a screening system which will entirely separate the dust from the stone and convey it to a separate bin.

(c) Size and Gradation.

(1) Coarse aggregate shall be generally rounded or cubical in shape and well graded from fine to coarse within each designated size range so that concrete of the required workability, density, and strength can be made without the use of an excess amount of sand, water, or cement.

For Class "A" concrete the maximum size aggregate shall be not more than 1-1/2 inches.

For Class "B" concrete the maximum size aggregate shall be not more than 3 inches.

For Class "C" concrete the maximum size aggregate shall be not more than 6 inches.

Coarse aggregate shall be separated, and the specified sizes delivered separately in accordance with the following:

3/16" to 3/4"
3/4" to 1-1/2"
1-1/2" to 3"
3" to 6"

Within any of the above-indicated size limits, not less than 85 percent of the material shall be retained on a standard square mesh screen of the minimum size aggregate indicated, and not more than 5 percent shall be retained on a standard square mesh screen of the maximum size aggregate indicated, and 100 percent shall pass a mesh screen 1-1/2 times the maximum size aggregate indicated.

(2) The grading of the combined coarse aggregate, in the mixed concrete, shall fall within the following limits:

| | (Percent by Weight) Passing |
|---|---|
| Maximum size mesh screen (square mesh) | 97 - 100 |
| 1/2 maximum size mesh screen (square mesh) | 40 - 70 |
| No. 4 sieve | 0 - 6 |

(d) Tests. - Coarse aggregates will be tested and shall be subjected to the following:

(1) Freezing and thawing test performed in accordance with A.S.T.M. Specification C137-39T, "Soundness of Aggregates by Freezing and Thawing," shall not show a loss in 25 cycles of more than 5 percent.

(2) Magnesium sulphate accelerated soundness test performed in accordance with A.S.T.M. Specification C88-39T, "Soundness of Aggregates by use of Sodium Sulphate or Magnesium Sulphate," shall not show a loss in 10 cycles of more than 10 percent.

However, aggregate failing to pass these tests may be used, with the approval of the contracting officer, provided it has given satisfactory service for a period of not less than 5 years under exposure conditions similar to those to which it will be subjected in the proposed work.

5-08. WATER. - The water used in mixing concrete shall be clean and free from injurious amounts of oil, acid, alkali or organic matter.

5-09. STORAGE.

(a) Cement.

(1) Immediately upon receipt, at the site of the work, cement shall be stored in a thoroughly dry, weathertight, and properly ventilated building or bin with adequate provisions for the prevention of the absorption of moisture. Storage shall be such as to permit easy access for inspection and definite identification of each shipment.

(b) Aggregates. - The fine and each size of coarse aggregates shall be stored separately and in such manner as to avoid the inclusion of any foreign material in the concrete. The aggregates shall be stored in free draining stock piles or bins for at least 72 hours prior to use. Stock piles of coarse aggregates shall be built in horizontal layers to avoid segregation. Sufficient live storage of all aggregates shall be maintained so as to permit continuous placing at the minimum rate specified in paragraph 5-12 (a) for at least 48 hours.

5-10. SAMPLING AND TESTING AGGREGATES. - Except where provided otherwise by these specifications, all sampling and testing of aggregates shall be made in accordance with the Federal Specifications. Unless specified otherwise, all test samples shall be supplied by the contractor at his expense and all tests will be made by and under the supervision of the Government at its expense. The source from which concrete aggregates are to be obtained shall be selected by the contractor well in advance of the time when they will be required in the work, and suitable samples, as they are to be used in the concrete shall be furnished to the contracting officer at least 30 days in advance of the time when the placing of the concrete is expected to begin.

The concrete aggregate shall conform in all respects to the requirements of these specifications. However, for the convenience of the contractor and in order to facilitate the wasting of any unsatisfactory material prior to shipping, inspection will also be made at the site of production and any aggregate which fails to meet all of the requirements will thereupon be rejected. Routine control tests and analyses of the aggregates in their various states from raw to finished products will be made by the Government, and the contractor shall provide such facilities as the contracting officer may consider necessary for the ready procurement of representative samples.

## 5-11 PROPORTIONING.

(a) Basis. - All concrete materials will be proportioned so as to produce a workable mixture in which the water content will not exceed the maximum specified.

(b) Control. - The exact proportions of all materials entering into the concrete shall be as directed by the contracting officer. The contractor shall provide all equipment necessary to determine, record, and control positively the actual amounts of the various materials, including water, cement, fine aggregate, and each individual size of coarse aggregate, entering into the concrete. The proportions will be changed whenever, in the opinion of the contracting officer, such change becomes necessary to obtain uniformity and workability or the specified strength, and the contractor will not be compensated because of such changes.

(c) Measurement. - All materials shall be measured by weight. One bag of cement will be considered 94 pounds in weight and 1 gallon of water as 8.33 pounds.

(d) Cement Content. - The cement content for each cubic yard of concrete shall generally fall within the following ranges:

| | |
|---|---|
| Class "A" | 5.0 to 6.0 bags |
| Class "B" | 4.0 to 5.0 bags |
| Class "C" | 3.0 to 4.5 bags |

For concrete deposited in water, the minimum cement content shall be 6.5 bags or 611 pounds to each cubic yard of concrete placed. The cement content shall be at all times subject to variation as deemed necessary by the contracting officer to attain the desired results.

(e) Water Content and Consistency of Concrete.

(1) In calculating the total water content in any mix, the amount of moisture carried on the surfaces of the aggregate particles shall be included. The total water content per bag of cement for each batch of concrete shall not exceed the following:

| | |
|---|---|
| Class "A" | 5.5 gallons or 45.8 pounds |
| Class "B" | 6.5 gallons or 54.1 pounds |
| Class "C" | 8.0 gallons or 66.7 pounds |

In all cases, however, the amount of water to be used shall be the minimum amount necessary to produce a plastic mixture of the strength specified and of the desired density, uniformity and workability. In general, the consistency of any mix shall be that required for the specific placing conditions and methods of placement, and ordinarily the slump shall be between 1/2 inch and 2 inches for Class "B" and Class "C" concrete, and between 1½ inches and 3 inches for Class "A" concrete when tested in accordance with the current specifications for "Method of Test for Consistency of Portland Cement Concrete," of the American Society for Testing Materials.

(f) Aggregate Content. - The total volume of aggregates to be used in each cubic yard of concrete shall be that necessary to produce a dense mixture of the required workability as determined by the contracting officer. The individual mixes will be based upon securing concrete having suitable workability, density, impermeability, and the required strength, without the use of an excessive amount of cement.

5-12. MIXING AND PLACING.

(a) Equipment. - The contractor shall provide at the site of the work a modern and dependable batch-type mixing plant with a minimum capacity of 1200 cubic yards of concrete per 8 hours. The plant shall include not fewer than 2 complete mixers of equal capacity with separate power plants. The equipment shall provide adequate facilities for the accurate measurement, record, and control of each of the materials entering the concrete. The complete plant assembly, including provision to facilitate the inspection of operations at all times and the adequacy and depenability of each of its parts, shall be subject to the approval of the contracting officer, and shall conform to the following requirements.

It shall be capable of ready adjustment for compensating for the varying moisture content of the aggregates and for changing the proportionate batch weights.

It shall be capable of controlling the delivery of each material to within 1 percent by weight of the designated amounts.

It shall be arranged to permit the convenient removal of material in excess of the specified tolerances, and acceptable facilities shall be provided for readily obtaining representative samples from the batches for test purposes.

Each weighing unit shall include a visible springless gage which will register the scale load at any stage of the weighing operation from zero to full capacity.

Insofar as practicable, each dial and water-measuring device shall be in full view of the operator and the weighing equipment shall be arranged so that the operator may conveniently observe the operation of the bin gates and also the materials discharged into the mixer hopper.

The accuracy of the weighing equipment shall conform to the requirements of the U. S. Bureau of Standards. The contractor shall provide standard test weights and any other auxiliary equipment required for checking the operating performance of each scale or other measuring device and shall make periodic tests, in the presence of a Government inspector, in such a manner and at such intervals as may be directed by the contracting officer; provided, that unless otherwise directed by the contracting officer, such check tests of equipment in operation shall be made at least once every two weeks. After completion of such check tests the contractor shall make such adjustments, repairs, or replacements as the contracting officer may consider necessary to secure satisfactory performance.

The plant shall include a device for accurately measuring and indicating the quantity of water entering the concrete and the operating mechinisms must be such that leakage will not occur when the valves are closed. The filling and discharge valves for the water tank shall be so interlocked that the discharge valve cannot be opened before the filling valve is fully closed.

It shall include a device for accurately and automatically measuring and indicating the time of mixing, which shall be interlocked to prevent the discharge of concrete from the mixer before the expiration of the mixing period.

It shall include a device for recording and indicating the number of batches handled.

Each set of units for measuring cement and mixing water delivered to one or more mixers shall be provided with an accurate combined autographic recorder for making a continuous visible record on a single chart of the measurement of all materials introduced into each batch, and of the consistency of the concrete during the mixing process. The recorder shall be housed completely, shall be capable of being locked, and shall be placed in a position convenient for use by the plant operator. The recorder paper furnished shall be ruled and printed so that each graph will be identified permanently and so that quantities and time may be read without scaling or calculation. Suitable means shall be provided to insure proper alignment, rate of travel, and tautness of the paper without wrinkling. The recording equipment shall include facilities for automatically registering on the chart the time of day at intervals of not more than 15 minutes and shall be designed for simplicity in operation and maintenance.

Each mixer shall be equipped with an efficient recording consistency meter or provided with equally suitable equipment or means satisfactory to the contracting officer for indicating concrete consistency and recording it on the combined autographic recorder chart. The sensitivity and range of the consistency meters shall be such that the effect of a change in slump of one inch shall be readily discernible to the operator, as determined by the contracting officer. The contractor shall furnish satisfactory evidence that the consistency meters which he proposes to use are adapted to the type of drum and loading of the mixers with which they are to be used. If the mixers are provided with consistency meters operating on the principle of measuring electrical input to the mixer motors, adequate means shall be provided for eliminating errors due to operating the motor from a variable-voltage supply source, with resultant changes in motor input which are not caused by changes in concrete consistency. If the contractor proposes to use means for the partial elimination and compensation of these errors, such means shall be subject to the approval of the contracting officer and the residual errors shall not exceed one percent of the values being measured. Errors in registration of concrete consistency caused by variable friction in the mixer equipment shall be eliminated or minimized by providing adequate anti-friction bearings and lubrication or by other means satisfactory to the contracting officer. All graphic charts recorded in accordance with this paragraph shall become the property of the Government.

(b) Mixing Time. - The minimum time for mixing each batch, after all materials are in the mixer, shall be as follows:

| | |
|---|---|
| 1/2-cubic yard mixer, or smaller | 1¼ minutes |
| 3/4- to 1½-cubic yard mixer | 1½ minutes |
| 1½- to 3-cubic yard mixer | 2 minutes |
| Larger than 3-cubic yard | 2½ minutes |

The mixer shall revolve at a uniform speed, a minimum of 12 revolutions per minute after all materials have been placed in it. Neither speed nor volume capacity of the mixer shall exceed those recommended by the manufacturer. Excessive overmixing, requiring additions of water to preserve the required consistency, will not be permitted. Should any mixer at any time produce unsatisfactory results its use shall be promptly discontinued until it is repaired or replaced.

(c) Conveying. - Concrete shall be conveyed from mixer to forms as rapidly as practicable, by methods which will prevent segregation or loss of ingredients. It shall be deposited as nearly as practicable in its final position. Chutes used shall be such that the concrete slides in them and does not flow. Chutes with a flatter slope than 1 on 2 will not be permitted.

There shall be no free vertical drop greater than 5 feet except where specifically authorized by the contracting officer.

Methods of conveying concrete to any part of the structure by which the concrete is loaded into chutes, belt conveyors, or other similar equipment or carried in a thin, continuously exposed flow, to the forms, will not be permitted except for very limited or isolated sections of the work, and then only when approved in writing by the contracting officer.

Placing of concrete in the dam shall, in general, be done by means of bottom-dump buckets of sufficient size to handle the full capacity of one mixer. The design of the buckets shall be subject to the approval of the contracting officer, and shall be such as to permit close regulation of the amount of concrete to be deposited in each dumping position. It is contemplated that the full capacity of a bucket may be deposited in one operation where this has no objectionable effect on the placement of concrete, but near forms and around embedded items or elsewhere as directed by the contracting officer, the discharge shall be controlled so that the concrete may be effectively compacted into layers not exceeding 18 inches in thickness with a minimum of lateral movement and accompanying tendency for segregation and the formation of rock pockets.

(d) Placing.

(1) Concrete shall be placed before initial set has occurred, and, unless otherwise authorized by the contracting officer, before it has contained its water content for more than 30 minutes.

(2) Concrete when deposited in the forms shall have a temperature of not less than 40 degrees F. and not more than 75 degrees F. However, when the temperature of the materials are such that the temperature of the fresh mixed concrete is 55 degrees of more, the mixing water shall be cooled to a temperature of 35 degrees F., and only aggregates taken from the coolest portions of the stockpiles shall be used. Any heating, cooling, refrigerating, or other operations necessary in order to produce a concrete having a temperature within the above specified temperature limits, (40° F. to 75° F.) shall be done by the contractor and the cost thereof shall be included in the unit prices bid in the schedule for the various classes of concrete.

(3) Unless otherwise specified, all concrete shall be placed in the dry upon clean, unfrozen, damp surfaces, free from running water, and never upon soft mud, dry porous earth, or upon fills that have not been subjected to approved rolling or tamping until optimum compaction has been obtained.

(4) Rock sufraces upon which concrete is to be placed shall be approximately horizontal or stepped, and shall be clean, solid, and free from oil, running water, mud, objectionable coatings, debris and loose, semi-detached, or unsound fragments and shall be sufficiently rough to assure satisfactory bond with the concrete. Immediately before concrete is placed, all such rock surfaces shall be cleaned thoroughly by the use of high velocity air-water jets, wet sandblasting, stiff brooms, picks, or other effective means satisfactory to the contracting officer. All pools of water shall be removed from depressions in order to insure proper bonding of the fresh concrete to the rock surfaces and no inflow of water into the foundation will be permitted. All necessary installations of riser pipes, headers, sand drains, and other installations necessary to produce a foundation free of running or standing water shall be installed by the contractor and so welded or otherwise securely fastened in place as to prevent their being jarred loose by concrete placement. No separate payment will be made for such installations. No wooden plugs or other organic materials will be placed permanently in any foundation. All absorptive surfaces shall be thoroughly wetted for 48 hours and spread with

a layer of mortar about 1/2 inch thick immediately before the concrete is placed. The mortar shall be of the same cement-sand ratio as used in the concrete.

(5) The layout of all monoliths shall be as shown on the drawings or as directed or approved by the contracting officer before concreting is commenced.

(6) All concrete shall be deposited in approximately horizontal layers, unless otherwise specifically authorized or directed by the contracting officer, and the concreting shall be carried on as a continuous operation, as far as practicable, until the placing in the course, section, panel or monolith is completed. Concrete must be covered within 45 minutes to one hour, depending on cement used, with fresh concrete during one pour. Lifts of mass concrete shall not exceed 5 feet in thickness except as shown on the drawings, and a minimum of 120 hours shall elapse between the finishing of one such lift and the starting of the next. In general a minimum of 24 hours shall elapse for each foot of thickness between the finishing of one lift and the starting of the next. The first two to four lifts starting from the foundation and from lifts which have been in place longer than 15 days shall be limited to a maximum height of 2 to 3 feet; as determined by the contracting officer.

Other lifts including spillway piers, shall generally have a minimum thickness of 4 feet, and a maximum thickness of 12 feet and a minimum of 72 hours shall elapse between the finishing of one such lift and the start of the next. In walls of buildings, lifts shall terminate at the tops and bottoms of the door and window openings.

(7) In dropping concrete through reinforcement, care shall be taken that no segregation of the coarse aggregate occurs. On flat surfaces where the congestion of steel near the forms makes placing difficult, a mortar of the same cement-sand ratio as is used in the concrete shall be first deposited to cover the forms.

(8) All top surfaces not covered by forms and which are not to be covered by additional concrete or backfill shall be carried slightly above grade and struck off by board screed (see paragraph 5-14 (a)), except that top surfaces of walls and piers not covered by forms and which are not to be covered by additional concrete or backfill when poured in excess of 10 feet in height in one pour, shall be carried not less than 2 inches above the specified finished elevation and struck off by board screed.

(e) Vibrating. - Concrete shall be placed with the aid of mechanical vibrating equipment as approved by the contracting officer.

(1) Internal vibrators shall be used in all sections 10-inches or more in width or which are sufficiently large to accomodate them. External vibration shall be used when directed by the contracting officer as auxiliary to internal vibration.

(2) Vibrators shall be of sturdy construction, adequately powered and capable of transmitting to the concrete not less than 5,000 impulses per minute when operating under load (immersed in concrete). The frequency of vibration shall be subject to proof by measuring the impulses radiated by the vibrator, when operating in concrete designed for the project, by use of a Frahm vibrating-reed tachometer or equal. The vibration shall be sufficiently intense to cause the concrete to flow or settle readily into place and show a visible effect over a radius of at least 18 inches in the concrete.

(3) A sufficient number of vibrators shall be employed so that, at the required rate of placement, vibration throughout the entire volume of each layer of concrete and complete compaction are secured. At least one

extra vibrator shall be constantly on hand at each point of placement (monolith) for emergency use.

(4) Form vibrators, where used, shall be attached to or held on the forms in such a manner as to transmit the vibration to the concrete effectively and shall be raised in lifts as filling of the forms proceeds, each lift being not more than the height of concrete visibly affected by the vibration. They shall be placed horizontally at distances not greater apart than the radius through which the concrete is visibly affected.

(5) Internal vibrators shall be kept constantly moving in the concrete and shall be applied at points uniformly spaced not farther apart than the radius over which the vibrator is visibly effective. The vibrator shall not be held in one location long enough to draw a pool of grout from the surrounding concrete. Internal vibrators shall be applied close enough to the forms to vibrate the surface concrete effectively, but care shall be taken to avoid hitting the forms sufficiently to damage them.

(6) The vibration shall be such that the concrete becomes uniformly plastic and there shall be at least 10 seconds of vibration per square foot of surface of each layer of concrete, computed on the basis of the visibly affected radius, and taking overlapping into consideration.

(7) Vibration shall be supplemented by forking and spading by hand adjacent to the forms on exposed faces. The concrete shall be compacted and worked in an approved manner into all corners and angles of the forms and around reinforcement and embedded fixtures.

(f) Construction Joints. - Vertical joints shall be formed at such locations and of such shapes and dimensions as shown on the drawings or as approved or directed by the contracting officer. Horizontal joints shall be continuous throughout all monoliths to produce continuous horizontal lines on the faces of the dam. The horizontal edges of each completed pour not required to be chamfered that are exposed to weathering shall be struck off level for a distance of about 6 inches back from the form to provide an even and neat appearance between construction joints. Where required, dowel rods shall be used.

All concrete in vertical members shall have been in place not less than 12 hours, and longer if so directed by the contracting officer, before concrete in horizontal members resting thereon is placed.

After the top surface ofa course is finally compacted, it shall be thoroughly protected from pedestrian traffic, materials being placed thereon, running water, or any activity upon the surface that might in any manner affect the initial setting of the concrete for a period of 4 to 20 hours as determined by the contracting officer. After the time required for initial set, the surface shall be washed with a high pressure air (air pressure capacity not less than 100 p.s.i.) and water jet to remove all laitance and to expose clean sound aggregate.

Immediately before placing is resumed in each succeeding course, all approximately horizontal construction joint surfaces shall be washed with a high pressure air and water jet and scrubbed with steel brushes and brooms. Sand shall be added to the air-water jet when required to remove algae, stains and other substances injurious to bonding. After final cleaning and immediately before placing is resumed the surface shall be wetted and spread with a layer of mortar 1/2 inch thick. The mortar shall be of the same cement-sand ratio as the concrete.

Where fresh concrete is to be placed against smooth surfaces of previously placed concrete, the surface of the previously placed concrete shall be roughened by picking, or other means approved by the contracting officer, in order to secure adequate bond. No payment will be made for such roughening but the cost shall be included in the contract unit price for the class of concrete affected.

(g) In Water. - When specifically authorized, concrete may be deposited in water having a temperature above 35 degrees F. The methods and equipment used shall be subject to the approval of the contracting officer. When deposited by the tremie method, the tremie shall be watertight and sufficiently large to permit a free flow of concrete. The discharge shall be kept continuously submerged in the concrete and the shaft kept full of concrete to a point well above the water surface. When the bottom-dump bucket method is used, the bucket shall not be dumped until after it has come to rest on the surface upon which the concrete is to be deposited. The bucket shall be provided with a suitable cover, and the bottom doors, when tripped, shall open freely. The bucket shall be completely filled and slowly lowered in order to avoid backwash, and when tripped, it shall be slowly withdrawn until entirely free of the concrete. With either method, concreting shall proceed without interruption until the top of the concrete is well above the water surface.

(h) Cold Weather. - Concrete shall not be placed when the ambient atmospheric temperature is below 35 degrees F. nor when the concrete is likely to be subjected to freezing temperatures before final set has occurred, unless specifically authorized by the contracting officer in writing. When so authorized, the materials shall be heated in such a manner that they will be free of ice, slush, snow, frozen lumps, etc., before entering the mixer. The temperature of the concrete when deposited in the forms shall be within the limits specified in paragraph 5-12 (d) (2). All methods and equipment for heating shall be subject to the approval of the contracting officer.

(i) Hot Weather. - For concrete placed during the extremely warm summer months and otherwise, when directed by the contracting officer, the contractor shall take whatever measures are necessary in order to produce a concrete having a temperature below the maximum limit specified in paragraph 5-12 (d) (2). The methods and equipment used shall be subject to the approval of the contracting officer.

5-13. TEST SPECIMENS.

(a) Number. - Test specimens, to determine whether the compressive strength of the concrete is in accordance with that specified in paragraph 5-03, will be taken by the Government inspector. At least 1 set of 3 specimens will be made for every major placement and, in general, for every 500 cubic yards of concrete placed, but in any event, a sufficient number of specimens will be taken to give a comprehensive knowledge of the concrete in each section of the work.

(b) Method. - All specimens will be taken from the concrete in accordance with the current specifications of the American Society for Testing Materials. The specimens will be tested by and at the expense of the United States, either in its laboratory or in that of a recognized commercial testing agency.

5-14. FINISHING.

(a) General. - Immediately after placement, the concrete shall be properly forked back along the faces of all forms by the use of concrete forks or spades and then re-vibrated unless otherwise specifically authorized or directed b contracting officer. The surface of concrete finished against forms shall be smooth, dense, and free from rock pockets. Immediately upon the removal of forms, all unsightly ridges or lips shall be removed and undesirable local bulging on exposed surfaces shall be remedied by tooling and rubbing to the satisfaction of the contracting officer; all holes left by the removal or omission of tie rods, and all similar voids unless otherwise directed by the contracting officer shall be neatly filled with cement mortar mixed in the same proportions as the original mix, provided that wherever practicable mortar which has been mixed and allowed to stand for one hour shall be used and placed as directed by the contracting officer. Defective concrete shall be repaired by cutting out the unsatisfactory material and placing new concrete which shall be formed with keys, dovetails, or anchors to attach it securely to the other work. This concrete shall be drier than the usual mixture and shall be thoroughly tamped into place. All finishing, tooling, rubbing and filling of the rod holes and all patching of exposed surfaces must be performed immediately after forms are removed and the succeeding course of concrete shall not be placed until the exposed surfaces of the preceding lifts have been finished to the satisfaction of the contracting officer. All surfaces of concrete, not covered by forms, that are not to be covered by additional concrete or backfill, shall have a wood float finish without additional mortar, and shall be true to elevations as shown on the drawings. Care shall be taken to see that all excess water is removed before making this finish. Other surfaces shall be brought to the specified finished elevation and left true and regular as approved by the contracting officer. Where considered necessary by the contracting officer, or where indicated on the drawings, joints shall be carefully made with a jointing tool. Every precaution shall be taken by the contractor to protect finished surfaces from stains or abrasions. No fire shall be permitted in direct contact with any concrete at any time. Concrete surfaces, or edges likely to be injured during the construction period, shall be properly protected by leaving the forms in place, or by erecting covers satisfactory to the contracting officer.

(b) Floor Surfaces.- Unless otherwise specified, all floors and other surfaces where indicated on the plans or required by the contracting officer, shall be finished with a 1 - inch monolithic sand-cement mortar surface. All water, laitance and any foreign matter shall be removed from the surfaces. The topping mixture shall be spread evenly over the base within 45 minutes after the base has been placed. The mortar shall be of 1 part cement and 3 parts approved clean sand. The cement and sand shall be thoroughly mixed dry and then sufficient water shall be added to produce a medium stiff mortar. After placing, the mortar shall be floated to a true, regular surface with a wood float and steel-troweled to a smooth finish. Troweling shall be the minimum amount consistent with obtaining a smooth dense surface and shall not be done until the mortar has hardened sufficiently to prevent excess fine material from being worked to the surface.

5-15. CURING.

(a) General. - Before actual concrete placement begins, the contractor shall have on hand and ready to install all equipment needed for adequate curing and protection of the concrete.

(b) Warm Weather. - All concrete shall be adequately protected from injurious action by the sun. Fresh concrete shall be protected from heavy rains, flowing water, and mechanical injury. All concrete shall be kept wet for a period of not less than 14 days by covering with water, or with an approved water-saturated covering or by a system of perforated pipes or mechanical sprinklers, or any other approved method which will keep all surfaces continuously (not periodically) wet. Where wood forms are left in place for curing, they shall be kept wet at all times to prevent opening at the joints and drying out of the concrete. Water for curing shall conform to the requirements of paragraph 5-08, and shall be generally clean and entirely free from any elements which, in the opinion of the contracting officer, might cause staining or discoloration of the concrete.

(c) Cold Weather. - Concrete when placed during cold weather shall be kept moist and provided with adequate protection, subject to the approval of the contracting officer, so that the air in contact with the concrete will be maintained at temperatures between 50 degrees F. and 70 degrees F. for at least the first 5 days. For massive section, where the atmospheric temperatures are sufficiently low, in the opinion of the contracting officer, to cause excessively rapid cooling and contracting of the exterior surfaces, the period for maintaining the temperature of the air in contact with the concrete between 50 and 70 degrees F. may be required to extend for 14 days. In extremely cold weather, the removal of temperature protection shall be done gradually so that the temperature of the air surrounding concrete is reduced to the outside air temperature at a rate not faster than 5 degrees F. in any one hour, or 50 degrees F. in any 24 hour period. Salt or other chemicals shall not be admitted into the mixture to prevent freezing.

## 5-16. FORMS.

(a) Materials. - Forms shall be of wood, steel or other approved material, except that the sheeting for all exposed surfaces shall be tongue-and-groove lumber of uniform width unless otherwise specifically authorized. Forms of like character shall be used for similarly exposed surfaces in order to produce a uniform appearance. The type, size, shape, quality and strength of all materials of which the forms are made and the design of the forms shall be subject to the approval of the contracting officer.

(b) Construction. - Forms shall be built true to line and grade, and shall be mortar-tight and sufficiently rigid to prevent displacement or sagging between supports. Where forms for continuous surfaces are placed in successive units, care shall be taken to fit the forms tightly over the completed surface so as to prevent leakage of mortar from the concrete and to maintain accurate alignment of the surface. Responsibility for their adequacy shall rest with the contractor. Their surfaces shall be smooth and free from irregularities, dents, sags, or holes when used for permanently exposed faces. Bolts and rods used for internal ties shall be so arranged, that, when the forms are removed, all metal will be not less than 2 inches from any concrete surface. Bolt holes shall be reamed with a suitable toothed reamer so as to leave the surfaces of the holes clean and rough and shall be filled with mortar as specified in paragraph 5-14 (a), immediately upon removal of the forms. Wire ties will not be permitted without the approval of the contracting officer, and at no time where the concrete surface will be exposed to weathering and where discoloration will be objectionable. All forms shall be so constructed that they can be removed without hammering or prying against the concrete. Unless otherwise indicated, suitable moldings shall be placed to bevel or round exposed edges, at expansion joints and/or any other points as may be required by the contracting officer.

(c) Coating. - Forms, except those lined with absorptive form lining, shall be coated with a non-staining mineral oil which shall be applied shortly before the concrete is placed.

(d) Removal. - Forms shall not be removed without the approval of the contracting officer, and all removal shall be accomplished in such manner as will prevent injury to the concrete. Forms shall not be removed before the expiration of the minimum number of days indicated below, except when specifically authorized by the contracting officer. When, in the opinion of the contracting officer, conditions on the work are such as to justify it, forms may be required to remain in place for longer periods.

| | |
|---|---|
| Arches, beams and slabs | 14 days |
| Columns | 7 days |
| Walls and vertical faces | 2 days |

(e) Absorptive Form Lining. - In addition to the requirements for work specified above, the forms for all permanently exposed surfaces, including the bridge piers above elevation 220, vertical surfaces of bridge deck, upstream and downstream faces of east and west bulkheads not covered by backfill and above elevation 235 on the upstream and above elevation 225 on the downstream faces, interior vertical and inclined surfaces in the compartments in the bulkheads, and interior and exterior vertical and inclined surfaces of the guardhouses shall be constructed of matched lumber approved by the contracting officer, and lined with absorptive lining. The absorptive form lining shall be capable through its absorptive capacity of eliminating voids, pits, and other common defects from the surface of the concrete placed against it. The form lining shall be highly absorptive to air and water and shall possess surface characteristics such as will result in a dense concrete with a satisfactory surface texture, and the minimum amount of sticking of the lining upon removal of the forms. The lining shall be readily adaptable to cutting, fitting and any other operation necessary in connection with its use. The lining itself, and any coating or treatment employed in its manufacture, shall be such as will not create discoloration or interfere with the normal chemical reactions of the cement in the concrete. The type of lining shall be subject to the approval of the contracting officer. Tests shall be made by the contractor of all proposed absorptive lining as directed by the contracting officer. These tests shall include the use of absorptive form lining on concrete surfaces in the dam which will be later covered by backfill. Samples shall also be furnished to the Government for laboratory tests, before approval of any type of lining by the contracting officer. Horizontal joints will not be permitted in absorptive form lining except at horizontal construction joints unless otherwise directed or approved by the contracting officer. Other joints in absorptive form lining shall be made only when directed or approved by the contracting officer. For cutting and trimming the absorptive lining, the contractor shall use tools which are well adapted for this work and are maintained in such condition that smooth edges will be produced. The joints between the sheets of absorptive form lining shall be fitted smoothly and accurately, and patching of the sheets of absorptive form will not be permitted. At joints, the edges of the form lining shall be in contact but shall not be pressed tightly together. Absorptive form lining shall be attached to the forms with only a sufficient number of nails or other means to hold the lining snugly in contact with the surface of the forms, and free from bulges and other imperfections that might cause unevenness or roughness of the concrete surfaces. Nails shall be driven so that the under side of the nailheads will be flush with the surface of the absorptive lining, and care shall be taken not to make dents in the surface of the lining with hammers or in any other manner. After the absorptive lining has been nailed in place, the joints shall be rubbed with a smooth tool to make the joints smooth and to press down any projecting fibers. In tightening the form anchors where absorptive form lining is in contact with the face of a previous lift, sufficient pressure shall be applied to compress the lining at the surface of contact so as to compensate for the reduction in thickness of the lining not in the surface of contact which will be caused by the pressure of the freshly placed concrete. Insofar as practicable, the contractor shall avoid splashing mortar or concrete on the absorptive lining and shall remove, without damage to the lining, such coatings as have set or become dry before the concrete is placed against the lining. Absorptive form lining of fibrous materials shall be used only once unless it can be demonstrated, to the satisfaction of the contracting officer, that re-use is practicable. After use, form lining shall be removed from the site of the work or disposed of as approved by the contracting officer. Forms lined with absorptive lining shall, in general, be removed or loosened early enough to avoid difficulty from sticking; except, the form shall be allowed to remain in place for a sufficient length of time to provide adequate support for the concrete, as determined by the contracting officer. Fibers from the lining which adhere to the concrete when the forms are removed, shall be removed without damage to the concrete, by brushing or other suitable means, as approved by the contracting officer. At all times subsequent to delivery of the absorptive form lining and prior to the placing of concrete against the lining, the contractor shall take all precautions necessary to protect the lining from becoming damp or wet to such an extent as to damage the material or to reduce its effectiveness as an absorptive medium. Particular care shall be exercised to protect absorptive form lining during clean-up operations, and temporary protection of such lining will be required. The use of absorptive form lining which has become wet or which contains visible external defects such as holes, ragged or untrue edges, breaks, cracks, tears, protuberances or indentations, will not be permitted.

## 5-17. PLACING STEEL REINFORCEMENT.

(a) General. - All reinforcing steel called for on the drawings or authorized by the contracting officer will be furnished to this contractor by the Government with freight paid to the contractor's terminal (see paragraph 1-10). The contractor shall unload and place all steel reinforcement, including rods, fabric and structural shapes as indicated on the drawings or otherwise required. The contract unit price for "Steel Erection; Concrete Reinforcing," shall include unloading, hauling to site, cleaning, proper storage and straightening, if necessary. All reinforcement shall be, when surrounding concrete is placed, entirely free from loose scale, dirt, grease or other coating which might destroy or reduce its bond with the concrete. All placing shall be in accordance with drawings furnished or approved by the contracting officer.

(b) Cutting and Bending. - Steel reinforcement will be mill bent. Miscellaneous bending that may be required at the site shall be in accordance with standard approved practice and by approved machine methods. Bar lists and bending schedules will be as shown on the drawings.

(c) Quality. - The steel reinforcing shall conform to the requirements of paragraph 9-05.

(d) Minimum Spacing of Rods. - The spacing of rods shall be as indicated on the drawings and the clear distance between parallel rods shall not be less than 1½ times the diameter of round rods, or twice the side dimensions of square rods, but in no case shall the clear spacing between the bars be less than 1½ times the maximum size of the coarse aggregate used in the concrete, unlesss specifically authorized by the contracting officer.

(e) Relation of Rods to Concrete Surfaces. - Except where otherwise indicated, reinforcement shall be placed as follows:

(1) All main reinforcement in massive concrete sections shall be placed not less than 4 inches from any concrete surface, unless otherwise specifically indicated or authorized.

(2) All main reinforcement in walls and slabs of buildings exposed to the weather and in fire-resistant construction, shall be placed not less than 1 inch from the surface in walls and slabs, 1½ inches in floor beams,

and 2 inches in girders and columns. In interior flat slab construction, the minimum cover may be reduced to 3/4 inch. For interior work where fire hazard does not exist, the main reinforcement shall be placed not less than 3/4 inch from the surface in walls and slabs, 1 inch in floor beams, and 1½ inches in girders and columns.

(3) The covering of stirrups, spacer rods, and similar secondary reinforcement may be less than the above dimensions by the diameter of such rods. The above dimensions shall be measured from the face of the reinforcement to the face of the forms.

(f) Splicing. - Where splices in reinforcement, in addition to those indicated on drawings or directed by the contracting officer, are necessary, there shall be sufficient lap to transfer the stress by bond. Rods shall be lapped not less than 40 diameters and splices shall be staggered. The lapped ends of rods shall be separated sufficiently or connected properly to develop the full strength of the rods. Adjacent sheets of mesh reinforcement shall be spliced by lapping not less than 6 inches, the lapped ends being securely wired together. The expense caused by any laps other than those indicated on the drawings or directed to be placed by the contracting officer, which are provided for the convenience of the contractor, shall be borne by the contractor.

(g) Supports. - All reinforcements shall be secured in place, true to the lines and grades indicated, by use of metal or concrete supports, spacers or ties as approved by the contracting officer. Such supports shall be of sufficient strength to maintain the reinforcement in place throughout the concreting operation, and shall be used in such a manner that they will not be exposed on the face of, nor in any way discolor nor be noticeable in the surface of the finished concrete. The cost of furnishing and placing all supports, spacers, ties and/or other devices required for reinforcement shall be included in the contract unit price for "Steel Erection; Concrete Reinforcing."

(h) Protection for Future Use. - Exposed reinforcement intended for bonding with future work shall be protected from corrosion by heavy wrapping of burlap saturated with bituminous material.

## 5-18. EMBEDDED ITEMS.

(a) Before placing concrete, care shall be taken to determine that any embedded metal or wood parts are firmly and securely fastened in place as indicated. They shall be thoroughly clean and free from coating, rust, paint, scale, oil, or any foreign matter. The embedding of wood in concrete shall be avoided whenever possible, metal being used instead. If wood is allowed, it shall be thoroughly wetted before the concrete is placed. Any air or water lines or other materials embedded in the structure as construction expedients shall conform to the above requirements and upon completion of their use shall be backfilled with concrete or grout as directed by the contracting officer. No payment will be made for such items nor for backfill of the items.

(b) For the placement of structural steel in piers, and of the gate frames see Section VII.

## 5-19. EXPANSION AND CONTRACTION JOINTS.

(a) General. - Expansion and contraction joints shall be constructed at such points and of such dimensions as may be indicated or required. The method and materials used shall be subject to the approval of the contracting officer and the materials shall conform to Federal Specifications wherever applicable. In no case shall corner protection angles or other fixed metals embedded in the surface of the concrete and bonded be continuous through an expansion joint.

(b) Built-up Joint Filler. - Joints between dam monoliths shall contain a built-up joint filler where indicated on the drawings and as described below unless otherwise directed by the contracting officer: the area of the joint between the metal water stop and the upstream face of the dam; areas of the joint between surfaces of the galleries and the surrounding metal water stops; and in other places, a strip 18 inches wide adjacent to final exposed surfaces. The filler shall consist of one thickness of 30 lb. asphalt-saturated roofing felt (See paragraph 9-30), joined to the concrete on each face of the joint by a uniform trowelled layer of bituminous cement Type "B" (See paragraph 9-18(a)).

(c) Preformed Joint Filler. - Preformed joint filler shall be used in the construction joints of the deck of the bulkheads and elsewhere as indicated on the drawings or otherwise required by the contracting officer. It shall be nonextruding and resilient preformed expansion joint filler conforming to type II, self-expanding cork, of Federal Specification HH-F-341, and shall be 1 inch thick as indicated on the drawings. Pieces of the joint filler which have been deformed, broken, or otherwise damaged shall not be used. Care shall be taken in placing so that strips of the joint material will butt tightly against the adjoining one.

(d) Rubber Filler for Joints. - A poured rubber joint filler conforming to the requirements of paragraph 9-14 shall be used in the construction joints of the deck of the bulkhead above the preformed joint filler. The poured rubber filler shall be used also in the construction joints of the roadway slab and elsewhere as indicated on the drawings or otherwise required by the contracting officer. The surfaces to be sealed shall be substantially dry and shall be thoroughly cleaned of all loose scale, dirt, and other foreign matter preparatory to pouring the joint filler. A block or form shall be used at each end to hold the material in the joint until it has set, and the filler shall be poured flush with the surface of adjoining concrete or steel. Precautions shall be taken to prevent pouring any material on the exposed surfaces adjacent to the joint.

(e) Water Stops, Bituminous and Metal. - Metal water stops shall be installed at vertical joints in the upstream and downstream walls of the compartments in the bulkheads and horizontally across the top of the mass concrete just below the compartments. The water stops shall be backed up by six inch diameter wells filled with special bituminous filler, type "C", containing a steam heating unit, all as detailed and shown on the drawings. The six-inch wells shall be formed by halved concrete pipe on one side of the well. The halved concrete pipe shall be non-reinforced, and of bell and spigot pattern, and shall conform to Federal Specification SS-P-371. The minimum thickness of shell shall be one inch and depth of socket two inches. The halved or split faces shall be smooth and in one plane.

As the dam progresses in height, sections of the steam heating unit shall be installed in the wells, and the wells shall be filled solid with bituminous material. The special bituminous filler, type "C" shall conform to the requirements of paragraph 9-18. After completion of the dam, each vertical joint shall be heated by steam until the bituminous material is melted, and additional bituminous material shall then be introduced under pressure until no more can be added under pressures up to 10 pounds per square inch or as directed by the contracting officer. The bituminous filler will be supplied to each well through a 4-inch wrought iron pipe opening into the compartments of the bulkheads. Inside this feeder pipe, and extending in a continuous circuit from the top to the bottom of the 6-inch well, and across the dam below the compartment shall be placed the 3/4-inch wrought iron steam pipe for use as a heater coil to soften the bituminous filler. The 4-inch wrought iron pipes shall extend beyond the surface of the concrete and shall be fitted with steel flanges as shown on the drawing. The wrought iron steam pipes and 3/4-inch nipple for supplying bituminous material shall extend 2 inches beyond the flange on the 4-inch pipe and shall be threaded and capped. All wrought iron pipe shall be genuine wrought iron conforming to the requirements of paragraph 9-20.

The metal water stops shall be of 16-gauge corrugated black iron 26 inches wide conforming to the requirements of paragraph 9-06, painted with bituminous paint, and crimped and bent as shown on the drawings. The ends of the strip shall be joined together and made watertight by welding which shall be subject to the approval of the contracting officer. Immediately after removal of the form, the exposed metal water stops, concrete pipe and steam pipe shall be protected by boxes approved by the contracting officer.

Other water stops of 16-gage corrugated black sheet iron conforming to the requirements of paragraph 9-06, painted with bituminous paint, and crimped and bent as shown on the drawings, shall be installed elsewhere as indicated on the drawings, or as otherwise required.

If supply conditions at the time of construction permit the use of copper water stops, the contracting officer may direct that they be substituted for the corrugated iron strips. In such event the contractor shall furnish and install the copper strips and the contract price will be adjusted for any difference in cost in accordance with Article 3 of the contract. Copper strips, if used, shall conform to paragraph 9-11.

(f) Copper seals supporting the joint filler and rubber filler (see (c) and (d) above) in the expansion joints of the deck of the bulkheads shall be 16 oz. sheet copper. Payment for furnishing and placing this item will be made at the contract unit price per pound for "Copper; Sheet."

## 5-20. MEASUREMENT AND PAYMENT.

(a) Concrete, General. - Measurement of concrete will be made on the basis of the actual volume of concrete within the neat lines of the structures as indicated on the drawings or otherwise required. Measurement of concrete placed against the sides of the excavation without the use of intervening forms will be made only within the neat lines of the structure. No deductions will be made for rounded or beveled edges or space occupied by metal work, electrical conduits, timber, nor for voids which are either less than five (5) cubic feet in volume or one (1) square foot in cross section. Unless otherwise specified, payment for concrete will be made at the respective contract prices per cubic yard for the various classes required, which prices shall include the use of all equipment, tools, material, false-work, forms and form lining, bracing, bolts, rods, metal ties, dowels, preformed expansion joint filler, rubber filler, built-up joint filler, canvas, mortar, labor, special provisions for hot and cold weather placing and curing, and all other items required to complete the concrete work.

(b) Additional Concrete. - Any other concrete to be placed and not specifically covered above will be paid for at that contract unit price for the concrete specified above which is most applicable to the additional concrete placed as determined by the contracting officer. The decision of the contracting officer regarding the classification of such additional concrete will be final. No payment will be made for any additional material which may be authorized by the contracting officer at the request of and primarily for the benefit of the contractor, which is not found necessary and required and directed by the contracting officer under the provisions of these specifications.

(c) Evaluation of Concrete Unit Prices. - Concrete unit prices will be evaluated for the use of either natural sand or crushed stone sand aggregate. (See Article 17 of Invitation for Bids.)

(d) Measurement and Payment for Steel Reinforcement. - Steel reinforcement will be paid for at the contract unit price per pound for "Steel Erection; Concrete Reinforcing." The weights for payment shall be based on the amount actually placed in accordance with the dimensions and details on the bar schedules furnished by the Government or placed as directed by the contracting officer. Unit weights used in determining computed weights will be as follows:

| Size of Bars, Inches | Weight, Pounds per Foot |
|---|---|
| 3/8 round | 0.376 |
| 1/2 round | 0.668 |
| 1/2 square | 0.850 |
| 5/8 round | 1.043 |
| 3/4 round | 1.502 |
| 7/8 round | 2.044 |
| 1 round | 2.670 |
| 1 square | 3.400 |
| 1-1/8 square | 4.303 |
| 1-1/4 square | 5.313 |

(e) Measurement and Payment for Water Stops. - Payment for furnishing and installing the bituminous cement in the wells in the water stops will be made at the contract unit price per cubic foot for "Special Bituminous Filler, Type 'C,'" measured in place to the section indicated or required. Payment for furnishing and installing the corrugated iron water seals will be made at the contract unit price per pound for "Corrugated Iron; Water Stops," and shall include all costs of painting, crimping, joining the ends, placing, and protecting. The payment for furnishing and placing the following items will be made at the contract unit price as follows: per pound for "Pipe; Wrought Iron," and per lineal foot for "Pipe; Concrete, Halved."

## SECTION VI - BRIDGE AND ROADWAY

6-01. GENERAL. - The bridge spanning the spillway section of the dam will consist of 40 steel girder spans, each approximately 60 feet in length to center of supporting piers, with a clear gate opening of 50 feet. The downstream part of the bridge will be a roadway 22 feet wide between curbs, supported on rolled girders. The upstream part of the bridge will be two separate box girders each supporting one rail of the gantry track. Provisions will be made for a future deck plate girder railroad bridge between the gantry girders. Construction and expansion joints shall be as indicated on the drawings or as otherwise approved by the contracting officer. The railroad bridge on the bulkheads will be of the same type construction as that described above for the spillway section.

6-02. STEEL GIRDER SPANS. - The steel girder spans shall be erected but not furnished by the contractor, see paragraph 1-10 and Section VIII.

6-03. CONCRETE. - The piers shall be of Class "B" concrete. The bridge floor including the railing piers above the bridge floor shall be of Class "A" concrete. Forms for curbs, facia, and railing pier shall be provided with form lining as specified in paragraph 5-16 (e). Forms shall be cambered for dead load deflection, as directed by the contracting officer, to avoid any sag in horizontal concrete lines or surfaces.

6-04. CONCRETE FINISHING.

(a) Pavement. - After the concrete in the roadway has been brought to a true uniform grade it shall be struck off with a heavy template to the cross-section indicated on the drawings. The pavement shall receive a wood float finish as specified in paragraph 5-14 (a). Prior to final finishing operations, the surface shall be tested for trueness of surface and grade and any deviation exceeding one-eighth of an inch in ten feet shall be immediately corrected.

(b) Curbs. - The curbs shall receive a wood float finish as specified in paragraph 5-14 (a) and shall be edged by steel trowel to a smooth dense surface.

6-05. MISCELLANEOUS.

(a) Roadway Drains. - The contractor shall furnish and install roadway drains complete as shown on the drawings. The drains shall be located and dimensioned as shown on the drawings, and the materials shall conform to the applicable requirements of Section IX.

(b) Bridge Guard Rail. - A guard rail shall be furnished and erected at the edges of the roadway where no other protection is provided, as shown on the drawings. The posts shall be 6-inch rolled steel H-beams and the two rails shall be 2½-inch standard steel pipe (see paragraph 9-19). The flanges at the upper end of each post shall be curved and welded into a cap as indicated on the drawings. The posts shall be anchored to the concrete in such a manner that they may be replaced if damaged. Each pipe rail shall be pinned to the post at one end and attached by a slip joint at the other. At the concrete piers the pipe rails shall be inserted in 3-inch pipe sockets embedded and anchored in the concrete. The pipes and posts shall be painted in accordance with the requirements of Section X.

(c) Handrailing. - (See paragraph 12-01).

(d) Paints and Painting. - (See Section X).

(e) Electric conduits pertaining to the power and lighting system shall be as specified in Section XII or shown on the drawings.

(f) All pipes and/or conduits which cross expansion joints shall be fitted with suitable water tight sleeves, satisfactory to the contracting officer, to allow for expansion and contraction at the joint. The weight of the sleeves will be included in the weight for the pipe or conduit of which they form a part.

(g) Gutters of 16 gage sheet iron covered both sides with approved bituminous paint shall be placed under the expansion joints in the spillway bridge deck as shown on the drawings.

## 6-06. PAYMENT.

(a) Payment for the bridge concrete will be made at the respective contract unit price for the class required and will include the cost of finishing the concrete surfaces.

(b) Erection of the steel girders for the bridge and gantry crane including all embedded parts and fastenings pertaining thereto will be paid for as provided in paragraph 8-06 (a).

(c) The payment for placing the gantry rails including rail clips, splice plates, and bolts as shown on the drawings, will be made as provided for in paragraph 8-06 (b).

(d) The weight of cast iron sidewalk and roadway drains, furnished and installed, shall be included in the bid item "Iron; Cast," and payment will be made at the contract unit price per pound for that item.

(e) Payment for furnishing, installing, and painting the bridge guard rail, including pipe railing, posts and anchorages, and sockets in the concrete piers will be made at the contract unit price per lineal foot for "Bridge Guard Rail" measured along the top rail between faces of concrete piers or between centers of end posts, if of steel.

(f) Payment for furnishing and placing sheet iron gutters will be made at the contract unit price per pound for "Steel; Structural," Miscellaneous."

## SECTION VII

## SPILLWAY GATES, GANTRY CRANES, AND APPURTENANCES

### 7-01. REQUIREMENTS.

(a) The work covered by this section comprises the hauling to the site, unloading, storing, erecting, painting, and testing of the spillway gates, gantry cranes, and appurtenances. Appurtenances include structural steel guide towers, gate, track and guide rails, sills, dogging equipment, lifting beams, crane collector bars and supports, and all castings, bearing plates, anchor bolts, machine bolts, field rivets, angle curbing, recess frames and other required fittings for the foregoing items. Placing of masonry plates, sills, and any other items requiring grouting in place shall include the grouting. All necessary fitting and welding for the foregoing items shall be included in the unit price for erection. Field painting shall be in accordance with Section X of these specifications. Field riveting and welding shall be in accordance with paragraph 12-13 of these specifications. Materials shall be as specified in Section IX. The work shall be complete as herein specified, but this section does not cover concrete work except for grouting incidental to erection of sills, masonry plates, anchor bolts and similar items.

(b) The material and equipment to be erected, except as noted below, including rivets and permanent connecting bolts, will be furnished by the Government. (See paragraph 1-10.) The contractor shall furnish the construction plant and all field paint, grease, grout (except cement) of approved mix, welding rods, fitting-up bolts, tools, appliances, and any other items incidental to handling, storing, erecting, painting and testing.

### 7-02. GENERAL DESCRIPTION.

(a) Embedded Parts. The embedded parts will consist of two structural steel guide towers in each spillway pier, towers in the bulkheads adjacent to the spillways, anchor bolts and masonry plates for the towers, portions of the crane collector enclosure, anchor bolts for the sills, angle curbing at the gate slots and recess frames for dog-operating levers, and for heater connection junction boxes. Each guide tower will be spliced at about mid-height.

(b) Gate Track and Guide Rails. The gate rails will consist of a 175# track rail and a 49.7# A.S.C.E. guide rail for each gate slot set vertically and fastened to the towers by cap nuts which are welded to the tower members, stainless steel studs and rail clips. Provision will be made for the adjustment of each rail both laterally and in an up-and-downstream direction. Similar guides will be provided for the gate storage slots, but the rails will be anchored directly to the concrete in the slots by anchor bolts and rail clips.

(c) Sills. The sills will consist of two structural steel rolled H-sections in each gate opening. The sills will be placed in grout slots left in the concrete of the spillway and will be held in place by anchor bolts and by field welds to the guide towers at the ends. Joints will be located at the contraction joints in the spillway.

(d) Dogging Assemblies. The dogging assemblies will consist of cast steel dogs in the piers operated by hand levers at the tops of the piers and vertical push rods running through pipe casings to the dogs. The dogs will be mounted on horizontal pins set in steel supports in the embedded towers.

(e) Spillway Gates. -

(1) The spillway gates will be of the fixed-wheel type with the wheels cantilevered outside of the end posts. A total of 33 full gates and 8 half gates will be furnished. The full gates include one spare gate and each consists of two sections, each 24 feet high and 52 feet between wheel tread centerlines. The top sections contain devices for coupling them to the bottom sections. The top sections are equipped with water seals consisting of staunching rods hung from the top of the gate at each side; but there are no side seals on the bottom sections and no horizontal seals. The eight half gates will be located in the first four openings at each end of the spillway and are identical to the top sections of the full gates except that lifting hooks similar to those on the bottom sections are provided in place of the lifting and coupling devices. The half gates will rest on concrete stoplogs which will take the place of the bottom gate sections in these 8 openings. Air discharge nozzles with supply pipes and connections are provided near the bottom of each top gate section and of each half gate.

(2) Each gate section and each half gate will require field splicing. Splices will involve riveting the end connections of the horizontal girders to the end posts, stitch-riveting the double girder web at the splice, riveting the skin plate and downstream tie plate splices, installing and aligning wheels, connecting grease lines and filling with grease, calking or calk-welding all joints in contact with headwater, and installing the lifting and coupling mechanisms in all of the top sections. The lifting and coupling mechanism is so designed that each gate may be lifted as a unit, or each section lifted separately.

(3) The water seals and the air discharge nozzles, piping and connections will be shipped separately to be installed by the contractor.

(f) Gantry Cranes. - Two gantry cranes operating on the same runway will be provided for operation of the spillway gates. The cranes will be identical except that crane No. 1 will be equipped with a gasoline-driven auxiliary generator for operation of the crane in case of failure of the main power supply. Electrical wiring will be so designed that the power from this auxiliary plant can be used to operate either of the two cranes. Each crane will be equipped with a lifting beam furnished with the gates. On each crane, gates will be handled by two 11 ½-ton fixed main hoists on a single trolley which will move up and downstream. A 10-ton auxiliary hoist will be provided on the trolley of each crane. The crane collector bars will be located in a steel inclosure on the upstream side of the upstream crane girder over the spillway, and in the upstream face of the east bulkhead section.

7-03. DRAWINGS. - The general arrangement of the material and equipment to be erected is as shown on the drawings. Complete erection drawings will be furnished the contractor by the contracting officer.

7-04. UNLOADING AND HANDLING. - All material and equipment shall be carefully handled during unloading and placing in final position so that no parts will be bent, broken or otherwise damaged. Hammering or wedging that will distort or injure the members will not be permitted, and members shall not be overstressed during the process of unloading, handling and erection. The contractor shall unload all material promptly upon arrival at the contractor's terminal, otherwise he shall be responsible for demurrage charges and/or damages. (See paragraph 1-10.) He shall check all material turned over to him against shipping lists and report any shortage or damage discovered promptly in writing to the contracting officer. If the sequence of operations requires it he shall store all material under cover and protect it from the elements until it is placed in final position.

7-05. EMBEDDED PARTS. - All parts embedded in concrete shall be clean and free from coating, rust, paint, scale, oil or any foreign matter. All anchor bolts and masonry plates shall be accurately set and grouted in place to lines and grades shown on the drawings. The gate guide towers shall be accurately plumbed and aligned and held rigidly in position by the anchor bolts and splices during depositing of the concrete. Curb angles and recess frames shall be field-welded at the points indicated on the drawings and held to true position while the concrete is being deposited. The tops of the heater casings in the towers shall be kept securely covered to prevent material from entering the casings.

7-06. GATE TRACK AND GUIDE RAILS. - After the pier concreting has been completed the guide rail on the upstream side of each gate slot shall be adjusted to a plumb position and to correct center-to-center distance from the rail in the opposite slot in the adjacent pier by means of the shims and adjusting studs. The 175# track rail on the downstream side of each gate slot shall then be adjusted to a plumb position and to the proper distance from and in line with the upstream rail in the same slot by means of the wedges and adjusting studs provided. The fastenings shall be drawn tight to secure a firm and rigid connection to the guide tower member. The rails will be match-marked in the shop before shipping, and care shall be taken that splices are made with the proper pieces and that the contours of the heads are flush at the joints.

7-07. SILLS.

The gate sills shall be set by means of the anchor bolts and adjusting nuts to proper line and grade in the grout slots provided. The whole sill assembly shall be held rigidly in place while the grout is being poured. Grout shall be poured flush with the top flange of the sill beam and the top surface of the spillway.

7-08. DOGS AND OPERATING DEVICES.- After the piers are completed the dogs shall be installed in the dog-supporting members in the piers and the pins driven. The operating rods, levers and grease piping shall then be installed. The operating rods shall be adjusted so as to permit free movement of the dog between extreme positions shown on the drawings.

7-09. GATES. - The gate sections will be completely assembled in the shop, holes for field rivets reamed and the sections match-marked before shipping. Care shall be taken to splice the proper sections. Splices shall be riveted except for points requiring welding for watertightness. Joints may be calked or calk-welded as authorized by the contracting officer. After the structural parts of the gate sections are spliced, the wheel assemblies shall be installed and the wheels adjusted to a true line by means of the eccentric provided in the axle. The wheels shall be held securely in this position by bars welded on either side of the flattened part of each axle to the inner vertical diaphragm of the gates. The bronze retaining nuts shall then be drawn tight. Grease piping shall then be installed and secured in place, the flexible connections made to the fittings on the wheel axles and the wheel bearings filled with grease. Each completely spliced section shall form a truly plane surface on the skin plate side, the end posts shall be parallel and at right angles to the horizontal girders, and the staunching rod supports shall be in correct alignment. After all sections are spliced, the lifting and coupling devices shall be placed in the top sections and connections made between the lifting bars and the sliding crossheads. Under no circumstances shall the gates be laid flat or tilted materially out of a vertical plane while the sections are coupled together. Particular care shall be given to aligning the gate wheels. After final assembly, lines through the center of the wheel treads at each end of any gate shall be in the same plane and parallel. Staunching rods shall be suspended so that they will move freely against the sealing surfaces in the slots.

## 7-10. CRANES, LIFTING BEAMS, AND COLLECTOR BARS.

(a) The gantry cranes with lifting beams shall be installed on the gantry runway and the collector bars shall be placed in the proper position in the slots provided. The contractor shall adhere to the best modern practice and workmanship in erection and testing of cranes, lifting beams, and collector bars and shall place all of his men working on the erection and testing under the supervision and direction of the erection engineer furnished by the crane manufacturer. The services of the erection engineer will be paid for by the crane manufacturer.

(b) The contractor will be permitted to use either or both gantrys and equipment in doing any work under this contract for which they are suitable, on condition that he shall provide competent operators and proper care for the cranes until the completion of the contract. He shall also provide any necessary temporary electric service lines and power for crane operation. Before the final contract payment is made, the contractor shall, if required by the contracting officer, repaint the cranes and make good to the satisfaction of the contracting officer any damage to them that may have resulted from the contractor's use thereof.

## 7-11. TESTING.

(a) After installation of the gate dogging devices, the parts requiring lubrication shall be greased with an approved lubricant and the whole assembly tested for satisfactory operation. The coupling devices shall be greased and tested for satisfactory operation, the centralized wheel greasing systems checked and wheel bearings filled with grease, using the portable grease pump furnished with the gates.

(b) After separate testing of the coupling and dogging devices, the gates shall be lowered into the slots and each gate tested by raising and lowering it several times throughout its full range. The dogging devices shall be tested by the operation of dogging each gate. Tests shall be repeated and necessary adjustments made in the gates, dogging assembly and guides until the operation of all equipment is satisfactory to the contracting officer.

(c) Field tests of the completed cranes, and lifting beams shall be performed by the contractor as directed by the contracting officer. Tests shall include the normal functions for which the cranes, and lifting beams are designed. The cranes shall raise, and lower, at the specified speed and hold in any position, test loads 25% in excess of their rated capacities. In addition, they shall transport on the runway at the specified speed, and with trolley in both extreme positions, test loads 25% in excess of the maximum weight of the heaviest gate section.

7-12. MEASUREMENT AND PAYMENT.

(a) The quantity to be paid for in erecting and placing in final position spillway gates, guide towers, guide rails, sills, dogging equipment, curbing, recess frames, and incidental items, shall be on the basis of weight determined as specified in paragraph 9-35. Payment will be made at the contract unit price per pound for "Spillway Gates; Erection," which payment shall cover all necessary material and work for erecting, fabricating, and painting, as indicated on the drawings or as called for in these specifications.

(b) Payment for the erection of the cranes, lifting beams, collector bars, and incidental items will be made at the contract lump sum price for "Gantry Cranes; Erection."

(c) All cement for grout will be furnished by the Government. The grout shall be the same cement-sand ratio as the adjacent concrete and as approved by the contracting officer.

# SECTION VIII - STRUCTURAL STEEL AND TRACKS

## 8-01. REQUIREMENTS.

(a) The work covered by this section comprises the hauling to the site, unloading, storing, erecting and painting, where required, of the steel girders for the spillway bridge, the inclosure for the crane collector bars, the gantry and rails on the spillway and bulkhead sections of the dam, the foot bridges over the railroad recesses in the piers, the nose armor for the spillway piers, the steel in the machinery, electrical and repair bays, and in the gate storage slots including guide rails and all other miscellaneous steel shown on the drawings excepting items for which payment is other wise provided. All necessary fitting, field riveting, welding, and placing of all castings, bearing plates, sole plates, bolsters, shoes, anchor bolts, turned bolts and other required fittings for the foregoing items shall be included in the work. Placing of any items requiring grouting in place shall include the grouting. Field painting shall be in accordance with Section X of these specifications. Field riveting, and welding shall be in accordance with paragraph 12-13 of these specifications. The work shall be complete as herein specified, but this section does not cover concrete work except for grouting incidental to placing of anchor bolts, masonry plates, end bearing details and similar items.

(b) The material and equipment to be erected, except as noted below, and including rivets and permanent connecting bolts will be furnished and delivered at the transfer yard by the Government. The contractor shall furnish the construction plant and all field paint, grout (except cement), welding rods, fitting-up bolts, tools, appliances, and any other items incidental to handling, storing, erecting, and painting.

## 8-02. GENERAL DESCRIPTION.

(a) The spillway bridge consists of the gantry run-way on the upstream side of the deck and a roadway bridge on the downstream side. The gantry rails are carried on steel box girders and the concrete roadway bridge slab is supported by steel rolled sections with transverse bracing. It is expected that each box girder will be shop fabricated and shipped to the transfer yard in one piece so that no field splicing will be necessary. The estimated weight of each box girder is 60,000 pounds and the heaviest girder in the roadway bridge is estimated to weigh not more than 9,000 pounds. The roadway bridge on the bulkheads will be of the same type construction as decribed above for the spillway bridge. The gantry tracks on the east bulkhead will be carried on reinforced concrete construction; there will be no gantry tracks on the west bulkhead.

(b) The inclosure for the crane collector bars consists of steel plates and angles attached to the upstream side of the upstream crane girder over the spillway and to the upstream face of the dam on the east bulkhead section.

(c) The gantry rails will rest on the box girders. The rails will be held in place by anchor bolts and rail clips and lateral adjustment will be provided by clearance in the clips. All rails will be curved to suit the curvature of the dam axis as shown on the drawings.

(d) Ladders with circular guards will be required on the spillway piers and other ladders with or without guards will be required as shown on the drawings.

(e) The steel in the gate repair bay will include removable guides, supports, and braces for the gate, runways and supports for hoists, supports and anchorages for machinery, and steel for hatch covers and coamings. Steel in the electrical bays will include supports and anchorages for electrical equipment.

(f) The steel in the gate storage slots will comprise structural bases to support the gates, guide rails with bearing plates and anchors, and steel for hatch covers and coamings.

(g) The nose armor for each pier will be a structural steel angle section held in place by strap anchors embedded in the concrete.

(h) Footbridges over the railroad bridge recesses in the piers shall consist of steel channels and floor grating as shown on the drawings.

8-03. DRAWINGS. - The general arrangement of the material and equipment to be erected is as shown on the drawings (See paragraph 1-04). Complete erection drawings will be furnished the contractor by the contracting officer.

8-04. UNLOADING AND HANDLING. - All material and equipment shall be carefully handled during unloading and placing in final position so that no parts will be bent, broken or otherwise damaged. Hammering or wedging that will distort or injure the members will not be permitted, and members shall not be overstressed during the process of unloading, handling and erection. Steel beams and girders shall not be laid flat. The contractor shall unload all material promptly upon arrival at the contractor's terminal, otherwise he shall be responsible for demurrage charges. He shall check all material turned over to him against shipping lists and report any shortage or damage discovered promptly in writing to the contracting officer. If the sequence of operations requires it, he shall store all materials under cover and protect them from the elements until they are placed in final position.

8-05. ERECTION.

(a) All anchor bolts, bearing plates, bolsters, shoes, bearing castings and similar items for supporting or holding in place the structural steel members shall be carefully set to proper line and grade as established by the contracting officer and maintained in this position. Bearing plates and castings shall be leveled by means of steel wedges or by shims or adjusting nuts if called for on the plans. Grout for setting them shall be of an approved mix and shall be so placed as to secure a full and uniform bearing. All structural steel surfaces to be embedded in concrete shall be thoroughly cleaned, free of grease, rust, mill scale, loose particles, dirt and other foreign material. Methods of cleaning shall be approved by the contracting officer. Structural steel not to be embedded will be delivered with a shop coat of paint.

(b) The gantry and roadway bridge girders shall be carefully set on the end bearings, held to true alignment, and firmly bolted in place. Particular care shall be given to proper arrangement of the expansion end details. Loads on the unbraced girders during construction shall be kept as nearly as possible symmetrical about the longitudinal axis. Transverse bracing for the roadway bridge shall be riveted.

(c) The enclosure for the crane collector bars shall be set firmly to correct grade and alignment.

(d) The rails for the gantry tracks shall be set on the box girders and anchored after the box girders are leveled and adjusted to proper grade and alignment. Care shall be taken that rails of the proper curvature are used, that the gage is accurately maintained, that the rails are truly level and at the correct elevations and that they are securely anchored in place. All splice bars and any other fittings shall be securely attached.

(e) Steel members in the machinery, repair and electrical bays shall be accurately set in proper position as shown on the plans. Bases for support of the gates in the storage slots shall be level and shall support the gate in a plumb position. The guide rails in the slots shall be accurately plumbed so that the rail heads at opposite ends of the same slot are in the same vertical plane and the proper center to center distance between rail heads maintained.

## 8-06. MEASUREMENT AND PAYMENT.

(a) The quantity to be paid for in erecting and placing structural steel in final position will be on the basis of weight determined as specified in paragraph 9-35. Payment will be made at the contract unit price per pound for "Steel Erection; Structural," which payment shall cover all necessary material and work for erecting, fabricating, and painting, and placing as indicated on the drawings or as called for in these specifications.

(b) Payment for placing the gantry and railroad rails including all fittings and anchorages as shown on the drawings will be on the basis of calculated weight and made at the contract unit price per pound in place for "Steel Rails, Placing."

(c) All cement for grout will be furnished by the Government. The grout shall be the same cement-sand ratio as the concrete adjacent to the grouting.

## SECTION IX

## METALS AND MISCELLANEOUS MATERIALS

### 9-01. GENERAL.

(a) Materials. - All materials shall be of new unused stock, free from defects. Substitution of size of sections and materials from that shown on the drawings or required in the specifications shall not be made except on written approval of the contracting officer and provided that the cost to the Government shall not be increased thereby.

Materials indicated on the drawings or required in the work and not covered elsewhere in these specifications by detailed requirements, shall conform to the requirements of this section.

Any materials required which are not covered by detailed specifications herein or elsewhere in the specifications shall conform to the applicable Federal Specifications, grade and/or class as required or, in case there are no applicable Federal Specifications, to applicable specifications of the American Society for Testing Materials (A.S.T.M.). In all other cases not specifically covered in these specifications the contractor shall furnish the highest grade commercial material or product.

(b) Inspection, Acceptance and Rejection of Materials. - All materials shall be subject at all times to inspection by the contracting officer who will select such samples in such quantities as he may deem necessary and subject the same to such tests as may be necessary to determine their qualities as herein specified, and he will accept or reject materials in accordance with the results of such tests. Tests may be repeated upon arrival of the various shipments at the site of the work to insure the acceptance of only such materials as will comply with the provisions of the plans and specifications.

(c) Test Specimens. - Special test specimens shall be furnished by the contractor on request, and shall be of such shape and number as designated, and shall in general conform to Federal Specifications or the specifications of the American Society for Testing Materials as to shape, size, and method of testing.

(d) Mill test reports. - Mill test reports certified to by qualified technicians shall be furnished when required for all material entering into this work and will, in general, be the basis of acceptance or rejection of the materials. The contracting officer may, however, require of the contractor special chemical or physical test on any part of the material if in his opinion the conditions justify such a check.

9-02. FEDERAL SPECIFICATIONS. - Copies of Federal Specifications referred to herein may be procured from the Superintendent of Documents, Government Printing Office, Washington, D. C., at a price of five or ten cents each. When the term: "Federal Specifications" or "A.S.T.M. Specifications" is cited, the reference shall be construed to mean the specifications as modified by any amendments promulgated before the date of opening bids for the contract. The number and designation of the Federal Specifications of A.S.T.M. Specifications for various materials to be furnished under this contract are as hereinafter enumerated.

9-03. CAST IRON SAFETY TREAD. - Cast iron safety tread shall conform in all respects to Federal Specification RR-T-661, for "Treads; Safety, Metallic", Type "B" and Class "6". Safety tread shall have a minimum thickness of 5/16 inch, and shall be of the lengths and widths shown on the drawings. Safety tread shall have a diamond pattern and shall have a nosing of not less than 1/4 inch. Treads shall be set flush with the surface and shall be firmly anchored.

9-04. STRUCTURAL STEEL. - Unless otherwise specified, all steel for general purposes shall conform to Federal Specification QQ-S-711a for "Steel, Structural; (for) Bridges", Class "A", except that the chemical properties shall be so controlled as to permit it to be easily welded by the arc-welding process.

9-05. CONCRETE REINFORCING STEEL. Reinforcing steel shall conform to federal Specification QQ-B-71a, for "Bars; Reinforcement", (for) "Concrete", Type "B" (Deformed). Bars shall be Grade 2 (Intermediate Billet Steel), or Grade 3 (Intermediate Car Axle Steel). The steel shall be properly identified as to grade.

9-06. SHEET METAL. - Sheet metal shall conform to Federal Specification QQ-1-696 for "Iron and Steel; Sheet, Black and Zinc Coated (Galvanized)" of the type and class as specified or required. When so specified, sheets shall also conform to definite chemical requirements.

9-07. BOLT STEEL. - Bolt steel shall conform to Federal Specification FF-B-571a and Amendment No. 1 dated April 1935 for "Bolts; Nuts; Studs; and tap Rivets (and Material for Same)", Class "B" steel, unless otherwise specified or required.

9-08. STEEL FLOOR GRATING AND FASTENERS. - Steel floor grating and fasteners shall conform in all respects to Federal Specification RR-G-661a for "Gratings, Steel, Floor (Except for Naval Vessels)", and shall be made of the material and class as specified or required.

9-09. IRON CASTINGS. (a) *Cast Iron.* - Cast iron, unless otherwise specified, shall conform to Federal Specification QQ-I-652 for "Iron, Gray; Castings", of class as required.

(b) *Cast Malleable Iron.* - Cast Malleable Iron shall conform to Federal Specification QQ-I-666 and Amendment 1, dated November 1934, for "Iron, Malleable; Castings", Black (Ungalvanized) Type "A", and Zinc Coated (Galvanized) Type "B".

9-10. *BRONZE CASTINGS CAPS*. - Bronze castings shall conform to Federal Specification QQ-B-691a for "Bronze; Castings". Type I, "Composition 4", unless otherwise specified or required. Castings for valves and fittings shall be Type I, "Composition 2".

9-11. COPPER. (a) *Plate and Sheets.* - Copper plate and sheets shall conform to Federal Specification QQ-C-501 and Amendment 1 dated November 1936 for "Copper; Bars, Plates, Rods, Shapes, Sheets, and Strips".

(b) *Piping.* - Copper piping shall conform in all respects to Federal Specification WW-T-799 and Errata - 2, dated April, 1934, for "Tubing; Copper, Seamless (For Use with Soldered or Flared-Fittings)", Type "K" or "L" as specified or required. Fittings for copper piping shall be die cast brass or copper fittings with capillary channel and feed holes for solder for sweating in place and shall bear the name of the manufacturer stamped thereon.

9-12. BRASS. (a) Sheets and Rolled or Drawn Shapes. - Sheets and rolled or drawn shapes shall conform to Federal Specification QQ-B-611a for "Brass, Commercial; Bars, Plates, Rods, Shapes, Sheets and Strips", Composition "C" of type and temper as specified or required. Metal for screws and bolts shall be composition "D", half hard.

(b) Castings. - Castings shall conform to Federal Specification QQ-B-621 and Errata 1 dated February 1934 for "Brass, Commercial and Naval; Castings", Composition "B" (Commercial brass castings).

(c) Pipe. - Pipe shall conform to Federal Specification WW-P-351 and Errata 1 dated October 1930 for "Pipe; Brass, Seamless, Iron-Pipe-Size, Standard and Extra-Strong", Grade "A".

(d) Pipe Fittings. - Pipe fittings shall conform to Federal Specification WW-P-448 for "Pipe-Fittings; Brass or Bronze (Threaded), 125-pound", or to Federal Specification WW-P-461 for "Pipe-Fittings; Bronze (Threaded), 250 pound", as specified or required.

9-13. SOLDER. (a) Solder shall conform to Federal Specification QQ-S-571 for "Solder; Tin-Lead", Grade "A" or "C" as specified or otherwise required.

(b) Solder for Brazing shall conform to Federal Specification QQ-S-551 for "Solder; Brazing", of composition as specified or otherwise directed.

9-14. RUBBER FILLER FOR CONCRETE EXPANSION JOINTS. - Compound shall be a thermoplastic rubbery, resilient, adhesive material, suitable for being readily poured into the joint at a temperature of 400-450 degrees F., and of a quick-setting type. The material shall remain homogeneous after prolonged heating at temperatures not lower than 450 degrees F. with no material change in character or viscosity. When poured, it shall solidify within 1 hour, shall adhere tightly to concrete, steel and bituminous surfaces, shall remain adhesive and resilient after prolonged exposure to freezing temperatures and to weathering, and shall be unaffected by dilute or concentrated solutions of calcium chloride. It shall have a softening point (Ring and Ball A.A.S.H.O. T-53) of not less than 80 degrees C. nor more than 95 degrees C. The material shall be similar and equal to "Thermoplastic" as obtainable from Dispersion Processes, Inc., Naugatuck, Connecticut, or "Rai-seal" as manufactured by Rubber Associates, Inc., New York City, or "Sealz" as manufactured by Solvents and Plastics Co., Louisville, Ky.

9-15. LIME. - Lime shall conform in all respects to Federal Specification SS-L-351, for "Lime; Hydrated (for) Structural Purposes", Type "M" or "F" as specified or required.

9-16. PUTTY. - Putty for glazing shall conform in all respects to Federal Specification TT-P-791a, "Putty; Pure-Linseed-Oil, (For) Wood Sash-Glazing", or TT-P-781 "Putty and Elastic Compound; fpr Metal Sash-Glazing".

9-17. PREFORMED JOINT FILLER. Preformed joint filler shall be cork conforming to Federal Specification HH-F-341 for "Filler, Expansion-Joint, Preformed; Non-Extruding and Resilient-Types (for Concrete)." Type II self-expanding cork, 1 inch thick.

9-18. SPECIAL BITUMINOUS CEMENT. (a) Type "B". - Type "B" shall be an internal set-up cement of asphaltic base, composed of a liquid asphaltic fluxing agent with an admixture of powdered asphalt, asbestos fibre and other suitable inorganic fillers. When mixed in the proper proportions, the cement shall be suitable for proper trowel application, and shall harden to a consistency as specified in subparagraph (3) below:

(1) The material shall be supplied in containers of proper relative size to apportion batches with the desired troweling consistency. The liquid asphaltic fluxing agent shall be a smooth uniform mixture, not thickened or livered, and showing no separation which cannot be easily overcome by stirring. The powdered cement shall be a uniform mix containing no matted lumps of fibre.

(2) When mixed in the proportions recommended by the manufacturer, the cement shall yield no less than 85 percent of non-volatile matter when 10 grams are heated in an oven at 105 to 110 degrees Centigrade for 24 hours.

(3) When tested in accordance with A.S.T.M. Specification D-5-25 for "Penetration of Bituminous Materials", the above mixture shall have the following characteristics:

Immediately after mixing, using a 5/8-inch diameter steel ball, 114 grams, 5 seconds, the mixture shall permit a penetration greater than 300. The same specimen, after a lapse of 24 hours at 25 degrees C. under water, shall permit a needle penetration, 100 grams, 5 seconds, of not more than 100. The same specimen after a lapse of 30 days at 25 degrees C. under water shall permit a needle penetration, 100 grams, 5 seconds, of not more than 50.

(b) Type "C". - Type "C" cement shall be an internal set-up cement as specified for Type "B", except that it shall have a melting point of between 50 and 55 degrees C., and shall have a needle penetration at 25 degrees C., of not less than 80.

9-19. STEEL PIPE AND FITTINGS. (a) Welded or Seamless Steel Pipe, Black or Galvanized, class and coating specified or required, shall be of standard commercial grade and sizes in conformity with Federal Specification WW-P-403a for "Pipe; Steel and Ferrous Alloy, Wrought, Iron-Pipe Size", except that test will not be required. Open ends shall be reamed. The pipe shall be straight, clean, and free from scale, rust, oil or other foreign matter.

(b) Fittings. (1) Screwed fittings shall be of standard weight, malleable iron, conforming to Federal Specification WW-P-521a for "Pipe-Fittings; Malleable-Iron (Threaded), 150 Pounds", black or galvanized as required, plain screw type. All fittings shall be of the same weight or grade as the pipe with which they are used.

9-20. WROUGHT IRON PIPE AND FITTINGS. - Wrought iron pipe and fittings shall conform to Federal Specification WW-P-441a for "Pipe; Wrought-Iron, Welded, Black and Zinc-Coated", of the class and sizes as indicated or required. Open ends shall be reamed. The requirements in the specifications for fittings for steel pipe shall apply also to fittings for wrought iron pipe.

9-21. CAST IRON PIPE AND FITTINGS.

(a) Pipe. - Unless otherwise indicated on the drawings or directed by the contracting officer, cast iron pipe shall conform to the specifications of the American Standards Association for Pit Cast Pipe for the class required. The pipe shall be furnished with the standard coal-tar-dip coating. Ends shall be either plain, bell and spigot, or American Standard flanged, as required. Cast iron soil pipe shall conform to Federal Specification WW-P-401 for "Pipe and Pipe Fittings; Soil, Cast Iron." Threaded cast iron pipe shall conform to Federal Specification WW-P-356 for "Pipe, Cast Iron; Drainage, Vent, and Waste (Threaded)."

(b) Threaded Fittings shall conform to Federal Specification WW-P-501a for "Pipe-Fittings; Cast-Iron (Threaded)" of type and class as shown or required.

(c) Flanged Fittings shall conform to American Standards, class as indicated or required.

9-22. EMBEDDED HANGER SUPPORTS. (a) Embedded Inserts for pipe supports shall be for threaded rods similar and equal to the adjustable loop type manufactured by the Grinnel Company, of the sizes required.

(b) Expansion Shields and Sleeves for Pipe Supports shall be for threaded rods of the sizes shown on the drawings, and of the type approved by the contracting officer.

9-23. STANDARD BOLTS, SCREWS, AND PINS. (a) Bolts, Nuts and Studs shall conform to Federal Specification FF-B-571a and Amendment 1, dated April 1935, for "Bolts; Nuts; Studs; and Tap-Rivets, (and material for same)". Unless otherwise specified or required, bolts shall be of Type "B-2" and nuts of Class "C" steel, type "A-2", with Class 3 medium fit. Zinc or cadmium coated bolts shall be furnished where specified, indicated or required.

(b) Machine and Set Screws shall conform to Federal Specification FF-S-91 for "Screws, Machine; (including Screws, Set)" Class 3 medium fit, unless otherwise specified. Machine screws shall be of the type and material required. Set screws less than 3/8-inch in diameter shall be Type "D", and those 3/8-inch in diameter and over shall be of Type "G" unless otherwise specified or required.

(c) Split Cotter Pins shall conform to Federal Specification FF-P-386 for "Pins; Cotter, Split" of the type as required.

9-24. LOCK WASHERS. - Lock washers shall be of the "Kantlink" type and shall conform to the S.A.E. standard dimensions and requirements, for lockwashers of regular section. Material shall be either S.A.E. X1055 or S.A.E. 1060.

9-25. STEEL WIRE ROPE. - Steel wire rope shall conform to Federal Specifications RR-R-571 and Amendment 3, dated August 1939, for "Rope; Wire" of sizes and types as specified or otherwise required.

9-26. CHAINS AND ATTACHMENTS. - Chains and attachments shall conform to Federal Specification RR-C-271 and Amendment 2 dated November 1934, for "Chain and Attachments; Standard, Miscellaneous". Chains shall be Type "A", Grade "II", and as otherwise specified.

9-27. FLOOR PLATING. - Floor plating indicated on the drawings shall be of carbon steel of the thickness specified or required, with a raised pattern on one side which will provide a non-skid surface in any direction. The reverse side of the plates shall be smooth. The specified thickness of the plate shall be exclusive of the raised pattern, which shall project not less than 5/64-inch and shall have a top free from sharp corners. They shall be closely spaced so that the foot will always be in contact with several of the raised portions.

9-28. BUILDERS' HARDWARE. (a) Builders' Hardware shall conform to the following Federal Specifications unless otherwise specified.

FF-H-106 and Amendment 1 dated November 1934 for
"Hardware, Builders'; Locks and Lock-Trim",
FF-H-116a for "Hardware, Builders'; Hinges".

(b) Locks shall be of the pin-tumbler type with not less than 5 tumblers, and shall be of weather and moisture proof construction. (See paragraph 12-18(a)(3)). Padlocks shall conform to Federal Specification FF-P-101a and Amendment 3 dated July 1939 for "Padlocks", Type 1a, size 1-3/4 inches. All padlocks shall be legibly stamped, "C. of E., U.S.A.".

9-29. PRESSURE LUBRICANTS. - Grease for pressure lubrication, except that for spillway gate wheel bearings, shall conform to Federal Specification VV-G-681 for "Grease; Lubricating, Mineral", "Medium" grade; pressure lubricant for spillway gate wheel bearings shall be that recommended by the bearing manufacturer and shall be effective at minus 40°F.

9-30. ASPHALT SATURATED FELT. - Asphalt-saturated felt shall conform to the requirements of Federal Specification HH-F-191, "Felt; Asphalt-Saturated, (for) Flashing, Roofing and Waterproofing."

9-31. PITCH. - Pitch shall conform in all respects to Federal Specification R-P-381, for "Pitch; Coal-Tar (for) Mineral-Surfaced Built-up Roofing, Water-Proofing and Damp Proofing," Type "I".

9-32. CONDUIT. - Rigid steel conduit, enameled, shall conform to Federal Specification WW-C-571, dated June 6, 1933, for "Conduit; Steel, Rigid, enameled".

9-33. TIMBER AND LUMBER.

(a) General. - All timber and lumber shall be straight, even-sawed, sound, and entirely free from all defects which might impair its durability or its usefulness for the purpose intended.

(b) Softwood shall conform to Federal Specification MM-L-751a and Amendment 1, dated April 1938, for "Lumber and Timber; Softwood," yard lumber, grades as specified or required.

(c) Hardwood shall conform to Federal Specification MM-L-736 and Amendment 2, dated June 1939, for "Lumber and Timber; Hardwood", yard lumber, grades as specified or required.

(d) Framing. - All timber shall be accurately framed and fitted and securely connected as shown on the drawings. Care shall be taken in framing to work out permissible defects wherever possible.

9-34. METALLIC COATINGS. - Zinc coatings shall be applied in a manner and of a thickness and quality conforming to A.S.T.M. Specification, A-123-33 for "Zinc (hot galvanized) Coatings on Structural Steel Shapes, Plates, Bars and Their Products." Sheradizing and cadmium plating shall have thickness and durability equal to or greater than zinc coating applied as specified above.

9-35. MEASUREMENT.

(a) The weights of structural steel members and of castings will be determined from the scale weight determined in the shop before shipment, or if the scale weight is not available, certified shipping weights shall be used. The contracting officer may check these weights by calculations and no payments will be made for weight in excess of 4 percent (4%) of the theoretical calculated weight. No weight allowance for painting will be made and the cost of painting shall be included in the unit prices bid. For concrete reinforcing see paragraph 5-20(d).

(b) All other materials for which payment is not specifically provided elsewhere will be paid for on the basis of the respective unit measures, as listed in the schedules at the unit bid prices.

## SECTION X - PAINTS AND PAINTING

10-01. GENERAL. The requirements set forth in this section include both shop and field cleaning and painting, but only the field cleaning and painting applies to this contract on those items furnished by the Government, see paragraph 1-10. Unless otherwise specified or authorized, all paint materials shall conform to the current Federal Specifications wherever applicable. Where Federal Specifications are not applicable, material shall be as specified, or otherwise subject to the approval of the contracting officer. All colors shall be as specified or subject to the approval of the contracting officer. All paint, when applied, shall provide a satisfactory film and a smooth even surface, except when sand reinforced, and undercoats shall dry without excessive gloss, suitable for the proper application and adhesion of subsequent coats, as approved by the contracting officer. Where necessary, in the opinion of the contracting officer, to suit the conditions of surface, temperature, and weather existing at the particular time of application, the packaged paint may be thinned by the addition of not more than one pint per gallon of mineral spirits (paragraph 10-10 (a)) immediately prior to application, provided that in no case shall the viscosity of the paint be reduced to a point where the specified maximum coverages will be exceeded. To distinguish several paint coats of the same color the contracting officer may require the addition of carbon black to give each coat a different shade.

10-02. SURFACE CLEANING AND PREPARATION.

(a) Shop Cleaning. - All ferrous surfaces to be painted shall be thoroughly cleaned of all millscale and other foreign substances to base metal, by sandblasting or any other method approved by the contracting officer.

(b) Field Cleaning. - All painted ferrous surfaces to be repainted which are not subject to submergence in water shall be cleaned and all dirt, oil, or other foreign substance shall be removed by mineral spirits or other approved cleaning agents, immediately prior to the application of field coats. All blisters and breaks in the paint film shall be cleaned to base surface by wire brush or scraper. Surfaces subject to submergence in water shall be cleaned of all paint, rust, dirt, and other foreign matter by sandblasting.

(c) Protection of Surfaces. - Care shall be taken to adequately protect all machinery parts, threads, and finished surfaces during cleaning and preparation.

(d) Inhibition. - All surfaces cleaned by sandblasting, or equally effective method, shall be treated with a chemical rust inhibitor (paragraph-10-07.). The inhibitor shall be applied as soon after cleaning as practicable, and prior to formation of any forms of corrosion from atmospheric moisture, or other causes. The inhibitor shall be applied by brush and permitted to dry. This chemical inhibitor however, shall be applied only under conditions such that the temperature of the surfaces to which applied and the air in contact therewith, are between 50 degrees F. and 110 degrees F., in order to insure proper chemical reaction with the metal. After drying, any unneutralized reactive residue on the surfaces shall be removed by thorough wiping with wet cloths. The inhibited surfaces shall then be permitted to dry thoroughly and shall be brushed with a broom to remove the dry dusty reaction product, after which a standard priming coat of paint, as indicated, shall be applied as soon as practicable, but in any event prior to deterioration or destruction of the inhibited surface. Should the inhibited surface be damaged or destroyed at any point by any means whatsoever, the surfaces shall be cleaned and retreated in approved manner prior to application of the paint.

## 10-03. PAINT APPLICATION.

(a) All painting shall be done in a neat, thorough and workmanlike manner. Except where otherwise specified or specifically directed, all paint coats shall be applied by either brush or spray in such manner as to produce an even coating of uniform thickness completely coating all corners and crevices. All painting shall be done by thoroughly experienced workmen. Care shall be exercised during spraying to hold the nozzle sufficiently close to the surfaces being painted to avoid excessive evaporation of the volatile constituents and loss of material into the air. Paint shall be applied only to surfaces that are thoroughly dry and only under such combination of humidity and temperatures of the atmosphere and surfaces to be painted as will cause evaporation rather than condensation. A practical test is to wipe a damp cloth on the surface to be painted. If the moist streak dries promptly, conditions conducive to evaporation prevail. In no case shall any paint be applied to surfaces upon which there is frost or moisture condensation, or during rainy or misty weather, without suitable protection as approved by the contracting officer. Painting during unfavorable weather conditions shall be carried on under a protective covering erected for this purpose. While any painting is being done, the temperature of the surfaces to be painted and of the atmosphere in contact therewith shall be maintained at or above 50 degrees F. All paint when applied shall be approximately (within fifteen degrees of) the same temperature as that of the surface on which it is applied. Where protection is provided for paint-surfaces, such protection shall be preserved in place until the paint film has properly dried and removal of the protection authorized by the contracting officer. Items which have been painted shall not be handled, worked-on or otherwise disturbed until the paint coat is completely dry and hard. After delivery at the site of permanent erection or installation, all shop-primed metal work shall be kept clean and free from corrosion. The surfaces shall be repainted or retouched from time to time, when in the opinion of the inspector it becomes necessary, using the same type of paint as the priming coat. Where field-painting at the site has been commenced on any portion of the work, the complete painting operation, including priming and finishing coats, on that portion of the work, shall be completed within 30 days after the date of such commencement. All coats on all painted surfaces shall be unscarred at the time of application of all succeeding coats, and when in the opinion of the contracting officer it becomes necessary, all coats shall be maintained by retouching or repainting, using the proper paints for the respective coats. After completion of painting, all glass, woodwork, and hardware and other surfaces not required to be painted shall be cleaned to the satisfaction of the contracting officer.

(b) Coverage. - The surface area covered per gallon for each type of paint specified shall be not greater than the following:

On smooth metallic surfaces:

| | |
|---|---|
| 1st Priming Coat - - - - - - - - - - - - - - - - - | 600 square feet |
| 2nd Priming Coat - - - - - - - - - - - - - - - - - | 425 " " |
| 1st and 2nd Finish Coats - - - - - - - - - - - - - | 550 " " |

On sanded priming coat:

| | |
|---|---|
| Sanded Primer Coat - - - - - - - - - - - - - - - - | 425 square feet |

| | | | |
|---|---|---|---|
| 1st Finish Coat | 250 | square | feet |
| 2nd Finish Coat | 300 | " | " |
| 3rd Finish Coat | 400 | " | " |

### 10-04 PRIMING COAT.

(a) Unpainted Surfaces.- The surfaces of all ferrous metal work to be embedded in the concrete, machined surfaces, surfaces requiring welding, and surfaces which will be in riveted contact shall not be painted unless otherwise specified.

(b) Structural Parts not subject to erosion, abrasion, or severe wear shall receive one shop and one field priming coat.

(c) Exterior Exposed Surfaces subject over extended periods of time to immersion in water, erosion by water, or to other abrasive action; namely, the entire exposed surfaces of all gates and other areas in contact with water, shall be treated as follows: After thorough removal of the protective shop coat of paint, dirt, rust, and other foreign matter, the surfaces shall be reinhibited and painted with one coat of Synthetic Red Lead Primer. In this coat, a heavy uniform course of perfectly clean sand (see paragraph 10-11 (f) ) shall be thoroughly and uniformly embedded within 15 minutes after application of the paint, or in any event before the paint has set to such extent as to prevent the proper embedment and adhesion of the sand particles. The sand shall be applied by air spray at reduced pressure or in any other manner which will insure thorough embedment of the maximum volume of sand particles without appreciable movement of the paint film. This coating shall be allowed to dry for a minimum of 48 hours prior to application of finish coats.

(d) Machinery and Mechanical Equipment (except threads and finished surfaces) subject to exterior atmospheric exposure, shall receive one shop-priming coat and a second field-priming coat after final erection in place in the structure. All shop-primed surfaces which will be inaccessible after fabrication shall receive an additional field-priming coat before assembling.

(e) Interior Machinery, Mechanical, and Electrical Equipment shall receive at least one Priming coat of an approved synthetic-varnish paint compatible with the synthetic enamel approved for finish coats.

(f) Machined Surfaces shall, immediately after final inspection be thoroughly cleaned of all foreign matter and coated with Rust Preventative Compound, U.S. Army Specifications 2-84A.

(g) Screw Threads shall be protected by a coating of heavy oil.

### 10-05. FINISH COATS.

(a) General.- Unless otherwise specified or authorized, the sand reinforced primed metal shall be given three coats of gray enamel finish paint. Exposed primed surfaces of all other metal work shall receive 2 coats of gray enamel finish paint. The priming coat over which it is applied shall be thoroughly dry and hardened, and at least a 24-hour interval shall be allowed between two successive finish coats and not less than 5 days for hardening of the final coat before being submerged in water. In any case, all finish painting shall be completed within 30 days after application of the first field-priming coat.

(b) Interior Mechanical and Electric Equipment and parts for installation within buildings, and not subject to either water or atmospheric exposure, shall, unless otherwise specified or authorized, receive two coats of Heat Resistant Primer and Finish-Metal, except that parts not subject to temperature in excess of 150° F, may be given two coats of a high quality synthetic resin enamel, similar and equal to "Lustrlife" Enamel as manufactured by the St.Louis Surfacer and Paint Company, St. Louis, Missouri.

### 10-06. PAINTS AND PAINT FORMULAE.

(a) General.- Paints shall have the composition as indicated below and shall be of a color matching the color clips attached or as otherwise approved by the contracting officer. All paints, shall be guaranteed by the manufacturer not to gel, liver or thicken deleteriously or form gas in a closed container within a period of one year from date of manufacture.

(b) Processing of Paints.

(1) Except where otherwise specified or authorized, all paint shall be made by grinding together dry or paste pigments and a liquid vehicle to form a smooth paint that will flow freely and will not settle or react deleteriously in containers.

(2) Grinding shall produce a fineness such that coarse particles and skins will not exceed 1.5 per cent (total residue left on No. 325 mesh screen, based on pigment). The grinding shall be done in a roll or pebble mill at temperatures that will not cause polymerization.

(3) Skinning shall be negligible after exposing 6 ounces of paint in a tightly closed 8 ounce glass container to sunlight for a total time of 24 hours.

(4) The resulting paint shall have satisfactory brushing and leveling properties, shall set to touch in not less than one hour nor more than four hours, unless otherwise specified, and shall provide a satisfactory film and a smooth even surface without undue gloss, suitable for proper application and adhesion of subsequent paint coats, as approved by the contracting officer. Sufficient suitable driers shall be added to make the paint dry hard within 18 hours.

(5) In view of potential variations resulting from variable processing equipment and technique, the manufacturer may be allowed, where necessary to produce the specified viscosities, to make slight changes in formula proportions, subject to specific approval of the contracting officer.

(c) Synthetic Red Lead Primer, to be used under all gray enamel finish coats shall be composed of materials conforming, where applicable, to the specified requirements and mixed in the proportions as follows:

| | |
|---|---|
| Red Lead | 16.5% by weight |
| Iron Oxide | 38.2% |
| Zinc Yellow | 5.5% |
| Diatomaceous Silica | 6.0% |
| Vehicle (see par. 10-06) | 28.0% |
| Thinner | 5.8% |

The paint shall have a consistency of flow of between 25 and 40 seconds through the 0.15 inch diameter orifice of a standard consistency cup when tested in accordance with the procedure specified in paragraph 9 and 10 of A.S.T.M., Specification D 333-37 for "Methods of Testing Nittocellulose Clear Lacquers and Lacquer Enamels." It shall have satisfactory brushing and leveling properties, shall set to light touch in not less than 2 hours nor more than 5 hours, and shall dry hard for recoating in not more than 18 hours, when tested in accordance with paragraph F-2d of Federal Specification TT-V-81a, entitled "Varnish; Mixing (for) Aluminum Paint." The vehicle shall be a synthetic resin varnish consisting of a phenol formaldehyde resin with the necessary oils and volatile thinners to produce elasticity, water-proofness, adherence, and durability in the finished paint film. It shall meet the detailed requirements of paragraph 10-08.

(d) Gray Finish Enamel.- Unless otherwise specified, all finish paint for all metal surfaces shall have the following composition and properties:

| | |
|---|---|
| Coloring pigments | 0.5 lbs. (approx) |
| Lead Titanate | 3.0 lbs. |
| Magnesium silicate | 1.0 lbs. |
| Acicular Zinc oxide | 0.25 lbs. |
| Vehicle (see paragraph 10-08.) | 1.0 gallon |

The paint shall have a consistency of flow of between 18 and 40 seconds through the 0.15 inch diameter orifice of a standard A.S.T.M. consistency cup. The enamel shall have good self leveling properties and when brushed or sprayed on a vertical surface at a coverage rate of 500 square feet per gallon shall dry hard and elastic without running, streaking, or sagging.

(e) Gray Heat Resisting Primer and Finish Paint for Metal shall have the following composition:

| | |
|---|---|
| Coloring Pigments | 1.0 pound (approx) |
| Titanium Dioxide | 3.0 pound |
| Vehicle | 1.0 gallon |

Driers- sufficient approved driers to made the paint dry hard in in 10 hours.

The vehicle shall be a glycerol-phthalate resin varnish of the following composition:

| | |
|---|---|
| Glycerol-Phthalate Resin Solution | 3/4 gallon |
| Mineral Spirits | 1/4 gallon |

The glycerol-phthalate resin solution shall consist of 70 percent by weight of glycerol-phthalate resin dissolved in 30 per cent by weight of xylol and shall be similar and equal to "Rezyl" No. 110, Solution No. "C", as manufactured by the American Cyanamide & Chemical Corporation, 30 Rockerfeller Plaza, New York, N.Y.

10-07. CHEMICAL RUST INHIBITOR, to be used where specified or required, shall be an approved compound of water, a wetting agent, a viscosity agent, phosphoric acid, and sodium dichromate. The concentration of the solution at the time of application shall be such that the Orthophosphoric acid ($H_3PO_4$) content shall be between 7.0 and 9.0 per cent (by weight) and the Sodium Dichromate approximately 0.75 per cent. Commercial chemical rust inhibitors of composition somewhat different from this may be acceptable in lieu thereof, subject to approval by the contracting officer of results of approved tests showing that the inhibitor, when applied in accordance with instructions of the manufacturer, will identically affect ferrous surfaces as the specified compound in the following ways:

(a) Chemically react with rust and surface metal to etch the surface, form a dull grayish coating of iron-chromate-phospate, and produce a rust-inhibited surface receptive to the firm bonding of the priming paint.

(b) After initially being thoroughly dried, the inhibited surface shall show no deleterious rusting when subjected to light rain or to other dampening agency for a period of not less than 4 hours.

(c) Leave no unneutralized active chemicals on the surface.

10-08. PHENOLIC RESIN VARNISH VEHICLE shall conform to the following requirements:

(a) Oil-resin ratio shall be 33 gallons of oil to 100 pounds of resin.

(b) Shall be clear and transparent and entirely free from resin, estergum or other non-phenolic resins. Not less than 50 per cent by weight of the vehicle shall consist of non-volatile oil and resin.

(c) The resin content shall be 100 per cent paraphenyl phenol-formaldehyde condensate similar and equal to Bakelite BR 254, and shall conform to the current U.S. Navy Department Specification 52R10 entitled "Resin Phenol-Formaldehayd."

(d) The volatile thinner shall contain not more than 80 per cent mineral spirits and not less than 20 per cent high flash coal tar naptha or high flash hydrogenated petroleum naptha and shall be free from toxic hydrocarbons such as benzol.

(e) The oil content shall be ternary oil mixture composed of 40% linseed, 30% liquid oiticica, and 30% "dehydrated" castor oil.

(f) The flash point shall be not below 30°C. in a closed cup tester.

(g) Shall pass a Kauri Reduction Test of 120 per cent, using the method described in paragraph F-2g, Federal Specification TT-V-81a, for "Varnish: Mixing (for) Aluminum Paint."

(h) Shall show no skinning after 48 hours in a 3/4 filled, tight container.

(i) Flow-out films on tin plate panels dried 72 hours shall withstand immersion in cold water for 96 hours, and in distilled water at 200° F. for 7 hours without showing more than a slight haze which shall disappear within one hour, and shall show no other signs of deterioration. The panel shall be allowed to dry and cool for 15 minutes after removal from hot water and shall then be inspected for signs of failure.

10-09. PIGMENTS.

(a) Carbon Black shall conform to either Federal Specifications TT-B-601, entitled "Boneblack: Dry, Paste-in-Japan, Paste-in-Oil" or Federal Specification TT-L-71 entitled "Lampback; Dry, Paste-in-Japan, Paste-in-Oil."

(b) Lead Titanate shall be similar and equal to Titanox "L" as manufactured by the Titanium Pigment Corporation.

(c) Red Lead shall conform to Federal Specifications TT-R-191a (97) per cent Grade for "Red Lead; Dry and Paste-in-Oil."

(d) Iron Oxide shall contain not less than 98 percent $Fe_2O_3$ and shall not contain any organic coloring matter.

(e) Diatomaceous Silica shall be an approved commercial grade.

(f) Zinc Yellow shall contain not less than 40 per cent $CrO_3$. It shall be a basic zinc potassium chromate, soluble in acetic acid, free from lead compounds, and containing no added zinc oxide, and shall be stable or non-reactive with the pigments and vehicles specified.

(g) Titanium Dioxide shall be similar and equal to either "Ti-Pure O" as manufactured by Krebs Pigment & Color Corporation of "Titanox NC" as manufactured by the Titanium Pigment Corporation.

10-10. THINNERS AND SOLVENTS.

(a) Mineral Spirits shall have the following properties:

Gravity----------------------43-47 degrees Baume
Flash Point (Closed cup)----100 degrees F. Min.
Initial Boiling Point--------300-310 degrees F.
End Point--------------------405 degrees F. Max.
A.S.T.M. Copper Strip Test--Negative
Solvency(Kauri-Butanol)-----41 cc (a) 77 degrees F. Min.

(b) Dipentine shall have the following properties:

| | Maximum | Minimum |
|---|---|---|
| Specific Gravity at 15.5° C. | 0.854 | 0.845 |
| Refractive Index at 20° C. | 1.477 | 1.472 |
| Unpolymerized Residue (percent (38N $H_2SO_4$) | 2.5 | |

A.S.T.M. Distillation Range:
5% Distilling at - - - - - - - - - - - 173 degrees C.
10% Distilling at - - - - - - - - - - - 175 degrees C.
97% Distilling at - - - - - - - - - - - 177 degrees C.
Collor-Lovibond 500 Amber - - - - - - - 3
Appearance: Clear and free from suspended matter.

(c) Toluol shall conform to U. S. Navy Department Specification 52T7 entitled "Toluene (Tuluol)", except that it shall have a solvency (Kauri-Butanol Method) of not less than 100 cc. at 77° F.

(d) Xylol shall conform to A.S.T.M. Specification D364-36 for "Industrial Xylene (Xylol) or 'Solvent Naphtha'", except that it shall have a solvency (Kauri-Butanol Method) of not less than 93 cc. at 77° F.

(e) Normal Butyl Alcohol (Butanol) shall conform to A.S.T.M. Specification D304-33 for "Butanol (Normal Butyl Alcohol)."

(f) Ethylene Glycol Monoethyl Ether shall conform to A.S.T.M. Specification D331-35 for "Ethylene Glycol Monoethyl Ether."

## 10-11. MISCELLANEOUS MATERIALS.

(a) Oil, Linseed JJJ-O-331 for "Oil; Linseed, Boiled," or JJJ-O-336, for "Oil; Linseed, Raw," as specified or required.

(b) Insulating Varnish, U. S. Navy Department Specification 52-V-13b, entitled "Varnish; Insulating, (for) Electrical Purposes."

(c) Creosote Paint for surface treatment of timber shall conform to Federal Specification TT-W-561a, entitled "Wood-Preservative: Creosote (for) Brush and Spray Treatment."

(d) Ortho-Phosphoric Acid ($H_3PO_4$), shall be a commercially pure product, in liquid form, containing not less than 75 per cent $H_3PO_4$.

(e) Sodium Dichromate, ($Na_2Cr_2O_7 . 2H_2O$) shall be a commercially pure product in crystalline form containing not less than 85 per cent $Na_2Cr_2O_7$.

(f) Sand shall be perfectly clean, dry, de-dusted, silica sand particles, graded so that not more than 5% will be retained on a No. 30 mesh sieve and not more than 5% will pass a No. 50 mesh sieve, and shall be obtained by a wet-washing process.

## 10-12. INSPECTION.

(a) Unless otherwise specifically authorized, inspection of all materials for the paints and chemical rust inhibitor and the manufacture thereof, will be made by a representative of the contracting officer. All smaples of materials and of the finished processed products will be tested and analyzed for conformity with the specifications by the Government. The inspector will collect for testing, samples of each of the materials to be used in the manufacturing processes and will then seal the materials to be used in the manufacturing processes and will then seal the material containers until test results from the samples indicate that the various materials conform to specifications. He will witness the breaking of the seals on the approved material containers and the compounding of the materials for the product being manufactured, will collect samples of the finished product for testing, and will witness the placing, sealing, and labeling of the finished product in containers for shipment. After the finished products have successfully passed the prescribed test, shipment of the sealed containers will be authorized.

(b) In the case of ready-mixed and packaged paints of standard manufacture, other than those specified by trade name, the contractor shall furnish a sample in the standard stock package, together with a certified copy of the complete chemical analysis, for test and approval by the contracting officer.

10-13. PAINT FOR MAINTENANCE. - To insure that paint used for maintenance after completion of the work shall match the original, the contractor shall furnish to the Government not less than one gallon and not more than ten gallons of each color used. The quantity of each color furnished shall be determined by the contracting officer from consideration of the severity of usage to which the surface on which it is applied is likely to be subjected.

10-14. PAINT SCHEDULE.

(a) Metal work shall be treated and painted as outlined in the following paint schedule. Items requiring painting that may not be specified or listed shall be painted as directed by the contracting officer.

(b) The different pipes and conduits in the galleries of the dam, and pipes in the service bays will be painted a different color for each class of service as approved by the contracting officer.

## PAINT SCHEDULE

| | | SHOP SURFACE PREPARATION & PAINTING | | | FIELD SURFACE PREPARATION AND PAINTING | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Sand Blast | Inhibitive Wash | Primer | Wire Brush and Wash With Mineral Spirits | Sand Blast & Inhib. W. | Primer | Two Finish Coats | Extr Finis Coat |
| Item No. | PARAGRAPH REFERENCE | 10-02 (a) | 10-02 (d) | 10-04 | 10-02 (b) | 10-02 (b) (c) | 10-04 | 10-05 | |
| 1 | Pipe Railing & Chains; Exterior | No | No | Red Lead | Yes | No | Red Lead | Gray Enamel | None |
| 2 | Steel Ladders | No | No | " | Yes | No | " | " | " |
| 3 | Steel Doors | No | No | " | Yes | No | " | " | " |
| 4 | Gantry Cranes | Yes | Yes | " | Yes | No | " | " | " |
| 5 | Flagpole | Yes | Yes | " | Yes | No | " | " | " |
| 6 | Manhole Covers & Frames | No | No | " | Yes | No | " | " | " |
| 7 | Piping (Exposed) | No | No | " | Yes | No | " | " | " |
| 8 | Hanger Bolts | No | No | " | Yes | No | " | " | " |
| 9 | Rabbet Angles & Miscellaneous Ferrous Metal | Yes | Yes | " | Yes | No | " | " | " |
| 10 | Exposed Parts of Spillway Gate Guides, Towers, Sills, Track, & Guide Rails; | Yes | Yes | " | No | Yes | Red Lead Re-inforced | " | " |
| 12 | Spillway Gates | Yes | Yes | Red Lead | No | Yes | Red Lead Re-inforced | " | Gray E Upstre Face |
| 13 | Spillway Bridge Girders | Yes | Yes | " | Yes | No | Red Lead | " | " |

10-15. PAYMENT for all paint and painting will be included in the contract price for the respective metals or items painted.

## SECTION XI - GOVERNMENT FIELD OFFICE

11-01. GENERAL. - The contractor shall construct a temporary field office for use by the field force of the contracting officer, complete and ready for occupancy in accordance with the drawings and specifications. The contractor shall complete the field office to such extent as will permit occupancy within 30 calendar days after date of receipt of notice to proceed and the entire building complete with all fixtures and installations shall be completed within 60 calendar days after receipt of notice to proceed. The building will be located at a site to be selected by the contracting officer after award of the contract. It is the intent of the Government to locate the building in the proximity of the contractor's office and shops at the site of the work. All materials specified shall conform in all respects to current Federal Specifications whenever applicable. All other materials shall be as specified or otherwise required by the contracting officer.

11-02. FEDERAL SPECIFICATIONS. - Applicable Federal Specifications for materials required for the field office are as follows:

### FEDERAL SPECIFICATIONS

| Material | Serial Number | Title |
|---|---|---|
| Galvanized Iron | QQ-1-696 | Iron and Steel; Sheet, Black and Zinc-Coated (Galvanized). |
| Steel Pipe | WW-P-403a | Pipe; Steel and Ferrous-Alloy, Wrought, Iron-Pipe-Size |
| Glass | DD-G-451 | Glass; Flat (for) Glazing Purposes |
| Lumber | MM-L-751b | Lumber and Timber; Softwood |
| Magnesia | HH-M-61 | Magnesia; Block, Cement, and Pipe Covering (Molded) |
| Pipe - Soil | WW-P-401 | Pipe and Pipe -Fittings; Soil, Cast-Iron |
| Pipe-Fittings | WW-P-501a | Pipe - Fittings; Cast-Iron (threaded) |
| " " | WW-P-521a | Pipe - Fittings; Malleable - Iron (threaded) 150 pounds |
| Roofing | SS-R-521 | Roofing and Shingles; Asphalt Prepared, Mineral-Surfaced |

Federal Specifications (Cont'd)

| Material | Serial Number | Title |
|---|---|---|
| Plumbing | WW-P-541a | Plumbing - Fixtures; (for) land use |
| Putty | TT-P-791a | Putty; Pure-Linseed Oil, (for) Wood-Sash Glazing |
| Venetian Blinds | LLL-B-441 | Blinds; Venetian, Wood-Slat (Type I) |
| Sheathing Paper | UU-P-536 | Paper; Sheathing, Waterproof |
| Wall Board | SS-W-51a & Amendment 1 dated October 1937 | Wall-Board; Gypsum |

11-03. EXCAVATION, FILLING AND GRADING

(a) The contractor shall make the necessary excavation for the parking lot area, foundation, footings, fuel tank, septic tank, pipings and drains as shown on the drawings. The contractor shall construct a parking space adjacent to the field office large enough to accomodate 15 automobiles; the area shall be graded, all rock or other obstructions removed, and the area covered with compacted bank run gravel to a minimum depth of 6 inches. The contractor shall provide suitable gravel surfaced driveways from the parking area to the contractor's access road; gravelled walkways necessary for access from office to parking area and roadways in the vicinity. All walkways shall be covered with 3 inches of rolled bank run gravel fill, built to line and grade as staked in the field.

(b) Furnace Room. - The foundation area covered by the furnace room shall be stripped to a depth sufficient to remove all vegetable matter, then refilled and tamped with previous material as directed by the contracting officer, to a grade 4 inches below the floor grade as shown on the drawings.

11-04. FOUNDATION. - The foundation and footings shall be of Class "B" concrete, having 1-1/2 inch maximum size aggregate, in accordance with Section V of these specifications, constructed to line and grade as shown on the drawings. The foundation posts shall rest on the footings and after being set to exact line and grade shall be anchored into place by backfill thoroughly tamped in thin layers to the height of finished grade as shown on the drawings. The girders supported on top of the posts and foundation shall be securely anchored thereto by bolting as shown on the drawings. Bolts in the foundation shall be placed during concreting operations.

11-05. CONCRETE FLOORS. - The floor in the furnace room shall be of Class "A" concrete, in accordance with Section V of these specifications, 4 inches thick, trowelled level, smooth and to a straight edge, or as specified. The furnace room floor shall have floor drain and trap located as shown on drawings, set 1 inch below floor grade and the floor trowelled smooth and to a straight edge from the drain to floor grade at each side. Reinforcing for concrete floors shall be 4-inch by 12 - inch welded wire fabric of No. 10 and NO. 12 wire gage.

11-06. FRAMING. - Lumber for framing shall be equal to No. 2 common fir. It shall be thoroughly seasoned, straight, even sawed, square cornered, sound and free from defects which may impair its strength, durability or its usefulness, for the purpose intended. All lumber shall be of commercial sizes, surfaced four sides unless shown or specified otherwise. The framework shall be constructed as indicated on the drawings and shall be erected in a substantial manner. Studding shall not be spaced over 16 inches on centers for exterior walls and not over 24 inches on centers for interior walls, doubled at all openings larger than the normal spacings and when cutting through joists, or rafters, headers shall be provided to double the framing around the openings. Double studs shall be provided at all corners of the building. Knee braces shall be provided from the corner studs to the fifth stud, diagonally from bottom plate to top plates at all corners of the building. Ridge board shall be provided at the ridge of the roof. All spiking of assembled members of framing shall be clinched by not less than 1/4-inch. Rafters and ceiling joists shall be spaced at 24-inch centers or as shown on drawing.

11-07. FLOORS. - Subflooring shall be nominal 1" x 6", 1" x 8", or 1" x 10" boards, S4S, laid diagonally with 1/16-inch joints between boards and nailed to each joist with two 10d nails for boards 6 inches wide or three 10d nails for boards wider than 6 inches. Nail heads shall be driven below the surface of the boards. Asphalt saturated felt weighing 15 pounds per 100 sq. ft. shall be laid on the subfloor. The finish floor shall be 5/8" x 3" tongue-and groove clear edge grain, kiln dried, B grade fir or equal, and shall be driven up tight, blind nailed, sanded, and oiled as specified in paragraph 11-19(b).

11-08. SIDING. - The outside faces of the building shall be covered with 25/32" asphalt-covered fibre sheathing similar and equal to Johns-Manville "Weathertite," nailed securely to every 2" x 4" stud with 8d flat-headed wire nails. A layer of 15-pound asphalt saturated felt shall be applied between the sheathing and the outside siding. The outside siding is to be asbestos-cement shingles similar and equal to Johns-Manville NO. 109U, laid according to the manufacturer's recommendations.

A 20 gage corrugated galvanized iron flashing shall be run continuously along the sill of the building and buried at least 12 inches below the finished ground line. Counter flashing of 24 gage galvanized sheet iron shall be applied as shown on the drawings. All seams shall be soldered. The galvanizing shall be Class "D" - Ordinary Coatings.

11-09. ROOFING. - Roof sheathing shall consist of 1-inch by 6-inch No. 2 fir or equal, matched and dressed on both sides with no beading. The roofing shall be double-coated strip shingle similar or equal to "Flintkote" roofing weighing not less than 210 pounds per square. The roofing shall be securely fastened with large headed, 3/4-inch galvanized roofing nails. All seams, nail holes and other breaks in the roofing shall be thoroughly sealed with an approved mastic roofing cement. The ridge shall be covered by a strip of roofing not less than 12 inches in width, bent over the ridge and securely sealed and nailed on each side. Galvanized iron flashing shall be provided and installed as shown on the drawings or as directed by the contracting officer.

11-10. WALLS AND CEILING.

(a) General. With the exception of the bathroom and furnace room, the inside of all exterior walls, both sides of all interior walls and all ceilings shall be covered with 1/2 - inch insulating board similar and equal to "Celotex" extending from floor to ceiling, securely fastened to all bearings. One-inch quarter round mouldings shall be provided at all corners. The edges of the insulation board shall be beveled at joints.

(b) Furnace Room. - The insulating board for walls and ceilings of furnace room shall be 3/8-inch gypsum board, applied and finished in accordance with subparagraph (a), above.

(c) Walls and Ceiling; Bathroom. - The ceiling shall be covered with 1/2-inch insulating board, similar and equal to "Celotex." The inside of the exterior wall and all interior walls shall have a covering of pressed wood 1/4-inch thick similar to "Tempered Presdwood" manufactured by Masonite Corporation, extending 4' - 0" above the floor. The exterior wall shall have 1/2-inch insulating board similar and equal to "Celotex" back of the pressed wood, and all walls above the pressed wood shall be covered with the same type of insulating board. Furring strips shall be used where required to make the finish surfaces of pressed wood and insulating board flush where they join each other, and the joint shall be covered with a moulding of 1-inch by 3-inch No. 2 fir or equal. The edges of the insulation board shall be beveled at joints. One-inch quarter round shall be placed at all vertical corners and in horizontal corners along the ceiling.

(d) Shower Stall. - The contractor shall furnish and install a commercial shower stall, complete with fittings, as shown on the drawings, similar and equal to "Marine No. 15," manufactured by the Fiat Metal Manufacturing Company, Chicago, Illinois.

(e) Ceiling Insulation. - Between all ceiling joists and extending over wall plates, as shown on the drawings, a rock fiber or chemically treated wood pulp insulating material 4 inches nominal thickness shall be installed. Insulation shall weigh not more than 10 pounds per cubic foot.

11-11. EXTERIOR TRIM. - Exterior trim shall be equal to No. 2 fir, finishing stock 3/4-inch thick except as otherwise noted. Door and window casings shall be 3/4-inch by 3-1/2 inches wide. All other exterior finish shall be to size as indicated on the drawings. Insulating wool of a quality satisfactory to the contracting officer shall be placed entirely around all window frames and around the jambs and heads of all door frames as shown on drawings.

11-12. INTERIOR WOOD FINISH. - All interior wood finish shall be equal to No. 2 fir finishing stock throughout, 3/4-inch or 13/16-inch thick and of sizes as indicated on the drawings. Water closet stalls shall be 6 feet - 4 inches high finished as shown on the drawings or as directed by the contracting officer. Over each lavatory a 16-inch by 24-1/2-inch mirror with white enamel metal frame shall be installed. Instrument cabinets shall be constructed as shown on drawing or as directed by the contracting officer.

11-13. WINDOWS AND FRAMES. - Windows shall be of stock pattern, with No. 2 fir, or equal, double hung sash or as shown on the drawings, glazed with clear glass. Windows in bathroom shall be single sash, hinged at bottom to open inward, glazed with clear glass, and fitted with cabinet latches. All frames shall be constructed so as to receive screens or storm windows, and as shown on the drawings. All glass will be as specified in paragraph 11-02.

11-14. DOORS AND FRAMES. - Exterior doors shall be solid construction, equal to No. 2 fir, 1-3/4 inches thick, designed as shown on the drawings. The upper part shall be of glass equal to that specified in paragraph 12-02, set in place with wooden stops on the inside and securely bradded and puttied outside. Interior doors, unless otherwise specified, shall be 1-3/8 inches thick, equal to No. 2 fir and shall have five cross panels. Standard stock doors of equal quality and size will be acceptable. Doors for water closets shall be 2' - 0" x 4' - 6" frames made up of 3/4" x 3-1/2" framing and covered with pressed wood 1/8-inch thick similar and equal to "Tempered Presdwood" manufactured by Masonite Corp. Doors for the instrument cabinet shall be 1' - 8" x 7' - 8" as shown on drawings, made up of 1-1/8" x 3" framing and covered with pressed wood 1/8-inch thick. The interior side of the furnace room door shall be covered with 28 gage galvanized iron as shown on the drawings.

11-15. SCREENS. - All windows and outside doors shall be equipped with screens. Window screen frames shall be constructed of No. 2 fir, or equal, 1-1/8 inches thick with 2-inch side and top rails and 3-1/2 inch bottom rails, divided at the center horizontally by a 2-inch rail. Screen door frames shall bo of same material and construction as specified for windows, but with two horizontal intermediate rails, one at 2-1/2 feet and one at 3.0 feet from bottom. Standard stock screen doors of equal quality and size will be acceptable. All screen wire shall be of 16 mesh to the inch, galvanized, conforming to Federal Specification RR-C-451a for "Cloth; Wire Screen". Type "D", stretched and secured with suitable wood strips, well bradded. Suitable screens shall be placed over the bathroom windows.

11-16. LOUVRES. - Wooden louvres shall be constructed and installed at both ends of the building as shown on the drawings. Removable screens and storm protection panels shall be furnished and installed in louvres, as shown on the drawings.

11-17. VENETIAN BLINDS. - All double hung windows, except in the furnace room, shall be fitted with venetian blinds with rust proof hardware fittings, automatic cord lock stopping device and spiral gear to tilt slats. The wooden slats shall be finished in ivory or cream color and the tape shall harmonize with the finish color of the wood. The blinds shall conform to the requirements of Federal Specification LLL-B-441 for "Blinds; Venetian, Wood-Slat", (Type I).

11-18. HARDWARE. - The contractor shall furnish and install all hardware specified below. All hardware shall be accurately and securely installed. At completion, all keys shall be delivered, properly labeled, to the contracting officer. All hardware shall be of stock design with sanded brass finish, and shall be of the following types, as specified.

(a) Entrance Doors.
2 sets - 1-1/2 prs. of 3-1/2" x 3-1/2" loose pin, butt hinges.
2 cylinder locks with 5-1/2" x 3-5/8" x 3/4" case.

(b) Interior Doors.
6 sets - 1-1/2 prs. of 3-1/2" x 3-1/2" loose pin, butt hinges.
6 Mortise locks with 3-5/8" x 3-7/8" case.
All locks shall be complete with two keys and approved knobs, latches and escutcheons.

(c) Windows.
100 Iron easy spring window bolts and fasteners.
2 prs. 1-1/2" x 1-1/2" tight pin, butt hinges.

(Bathroom windows.)

2 - Cabinet latches. (Bathroom windows.)

(d) Water Closet Doors.
2 latches and keepers.
2 pr. spring hinges (for 3/4-inch doors.)

(e) Instrument Cabinets.
4 night locks complete
4 pr. cabinet hinges (for 1-1/8-inch doors).

(f) Miscellaneous.
54 screen hangers complete
29 - 3-inch hooks and eyes.
2 pr. screen door hinges.

The contractor shall furnish and install all other hardware and minor parts that may be necessary to complete the contract.

### 11-19. PAINTING.

(a) Exterior. - Before applying any paint the surface to be painting shall be thoroughly dry and free from dirt, oil, grease and other foreign substances. As soon as complete the outside surfaces, of windows, doors, and screen frames shall be given one priming coat of paint, conforming to Federal Specification TT-P-36a for "Paints; Lead-Zinc-Base, Ready-Mixed and Semipaste, White and Tinted". After the priming coat has thoroughly dried, one finishing coat of white outside house paint, shall be applied to all wood surfaces, except the outside trim. All outside trim surfaces shall be painted with one finishing coat of green, medium shade, outside paint as approved. All paint for finishing coats shall be stock No. 6 B S-W ODP White Lead as manufactured by the Sherwin Williams Company, or equal.

(b) Interior. - All interior woodwork, except floors, shall be painted with two coats of inside paint of approved manufacture and color. All finished floors shall be given one heavy coat of boiled linseed oil.

11-20. PLUMBING.

(a) All labor and materials required for installing a complete plumbing system shall be provided as indicated on the drawings and in accordance with these specifications and in accordance with any State or local regulation, and the publication "Recommended Minimum Requirements for Plumbing in Dwellings and Similar Buildings", issued by the Bureau of Standards.

(b) The plumbing fixtures and accessories shall be similar and equal to those designated below, reference being made, for identification only, to catalog numbers as listed in Kohler Co. Catalog K-39.

2 Closets, No. Brooklands K-3940-PR complete with fittings.
2 Toilet paper holders.
2 Lavatories No. Clare K-3000-P with fittings.
1 Floor drain and trap.
1 - 3'-0" Urinal - Jarves No. K-5052-A complete with fittings.

(c) The field office shall be supplied with a constant and uninterrupted potable water supply of not less than 35 and not more than 50 pounds per square inch pressure, furnished by the contractor. The supply line shall be 3-inch pipe placed in a trench of sufficient depth and protected to prevent freezing in subzero weather. At the point of entrance, in bathroom, a main shut-off and drain cock shall be installed. Pipe sizes and valves shall be as shown on the drawings. An automatic electric hot water heater of 30-gallon capacity shall be furnished and installed. The heater shall be similar and equal to Westinghouse Electric Manufacturing Company's Square Type Electric water heater, installed to manufacturer's specifications.

(d) The contractor shall lay a 4-inch vitrified pipe sewer line from the end of the cast iron soil pipe, outside the building to the sewage disposal tank located not less than 50 feet from the building. Vitrified pipe shall conform to the requirements of Federal Specification SS-P-361 for "Pipe; Clay, Sewer". The sewer shall be laid with 1/4-inch to 1-foot pitch, true to line and grade, and made up with tight joints. The sewage disposal tank shall be similar and equal to Kaustine Standard Series Horizontal Septic Tank No. 85, and provided with proper connections for outlet and inlet pipes. The outlet shall connect to a grid system not to exceed 780 feet of 4-inch field tile pipe including connections. The joints of the field tile pipes shall be laid open, 1/4-inch, and top half of each joint shall be covered with sheathing paper. If the field office is conveniently located, the sewer line from the Government Field Office may be connected to the sewer disposal system of the contractor's office, provided the system is designed to carry the extra sewage, subject to approval by the contracting officer.

11-21. ELECTRICAL WIRING. - The contractor shall secure all permits and give such notices as required by state and local authorities. The installation shall be in strict accordance with the National Electrical Code. The system shall be 3-wire, 220/110, singlephase, solid neutral, rigid metal conduit to fuse cabinet as indicated on drawing. All wiring shall be rubber-insulated, non-metallic sheathed cable, similar and equal to "Wireflex" as manufactured by the Wiremold Co. The building shall be wired as indicated on the drawings. Three main feeders of not less than No. 8 AWG wire shall be installed in 1-inch conduit. The ground wire shall be not less than No. 8 AWG. The entrance switch shall be outside type, 3-wire, solid neutral, 2-pole, 30-amp. Fuse cabinet shall be flush type, steel with door and built for 6 circuits, with solid neutral, motor switch. The motor switch shall be of the automatic thermal protection, reset-type. Each circuit shall be fused with 15-amp. fuses, Duplex plug receptacles or convenience outlets shall be 15-amp., 125-volt, with stamped brass plates. At completion, all circuits shall be plainly marked for identification. The contractor shall furnish and erect in first class manner, all fixtures complete with shades and lamps of the wattage indicated, fuses and all other necessary accessories. The fixtures shall be similar and equal to those designated below. Reference is made, for identification only, to catalog numbers as listed in Benjamin Electric Mfg. Co., catalog entitled "Benjamin Sockets for Reflector Fixtures".

SCHEDULE

| Location No. | No. | Type |
|---|---|---|
| Inspector's Office | 2 | 5642 - PUL R.L.M. Dome with canopy and fixture stud. |
| Clerk's Office | 1 | 5642 - PUL R.L.M. Dome with canopy and fixture stud. |
| Furnace Room | 1 | 5423 Shallow Dome with canopy and fixture stud. |
| Bathroom | 1 | 5423 Shallow Dome with canopy and fixture stud. |
| Bedroom | 1 | 5642 - PUL R.L.M. Dome with canopy and fixture stud. |
| Field Engineers Office | 1 | 5642 - PUL R.L.M. Dome with canopy and fixture stud. |
| Drafting Room | 3 | 5642 - PUL R.L.M. Dome with canopy and fixture stud. |
| Platform | 2 | 6821 Watertight angle with round box. |

The contractor shall do all cutting and placing of supports necessary in this work.

### 11-22. HEATING.

(a) General. - The contractor shall furnish and install an oil burning automatic controlled furnace similar and equal to Mueller's No. 55 B. G. Fuel Oil Furnace. The installation and workmanship shall be in strict accordance with the specifications of the manufacturer, rules and regulations of the National Board of Fire Underwriters and local requirements.

(b) Grills, Registers and Ducts. - All grills and registers shall be furnished and installed by the contractor as shown on the drawings or as directed by the contracting officer. Warm air grills shall be provided with independently adjustable, manually controlled vertical fins for deflection of air. Cold air return register shall be plain lattice type, suitable for floor or wall installation and of the size indicated on the drawings. The hot and cold air duct, register and grill system shall be constructed in accordance with manufacturer's specifications, and installed as shown on the drawings or as directed by the contracting officer.

(c) Smoke Pipe and Vent. - The smoke pipe and vent shall be as specified by the manufacturer for furnace used. The smoke pipe from furnace to 2-inches above roof, shall be covered with asbestos air cell pipe covering, 1-inch thick, properly secured to the pipe.

(d) Fuel Tank. - A fuel supply tank of 500 gallons capacity shall be furnished and installed by the contractor. The tank shall be under ground and covered with not less than 2 foot of well tamped backfill. Fuel tank and all piping shall meet all requirements of the National Board of Fire Underwriters.

11-23. FIRE PROTECTION. - The contractor shall furnish and install one frost proof fire hydrant with suitable connections for two 1-1/2 inch fire hoses. The fire hydrant shall be installed not more than 25 feet from the building and shall be supplied with water at a pressure not less than 35 pounds.

11-24. FLAGPOLE. - The contractor shall furnish and erect one flagpole complete with pulley and rope, as shown on drawings. The flagpole shall be constructed of one 12-foot lenght of 2-1/2 inch and one 12-foot length of 2-inch galvanized steel pipe, with an overlap of 1 foot at joint securely welded. The flagpole shall be securely fastened to a concrete base as shown on drawings and shall be so attached that bottom bolt can be removed and pole revolved about upper bolt to a horizontal position or as directed by the contracting officer.

11-25. REMOVAL OF BUILDING.- Upon completion and acceptance, the field office will become the property of the United States and will be removed by the Government. No materials or equipment shall be salvaged by the contractor.

11-26. PAYMENT. - Payment for the field office complete, including the furnishing of all labor, plant and materials necessary to complete the building in accordance with these specifications and as shown on the drawings, and including parking area, driveways, walks, and grading around the building, will be made at the contract lump sum price for "Field Office" upon acceptance of the building by the contracting officer. The contracting officer retains the right to order the contractor to make an extension as indicated on the drawings, with similar construction and equipment as the original building. Payment for the extension, if any, will be made at the lump sum price for "Field Office Extension".

## SECTION XII

## MISCELLANEOUS ITEMS AND EQUIPMENT

### 12-01. PIPE HANDRAILING.

(a) General. -Handrailing with required and necessary fittings shall be furnished and installed on the spillway piers, the upstream gantry girder, the deck of the west bulkhead, at stairways, and at other places as designated on the drawings or as directed by the contracting officer. All handrailing shall be of standard weight black steel pipe conforming to the requirements of paragraph 9-19 of these specifications and dimensioned and supported as shown on the drawings. The fittings shall be of malleable iron, ball pattern, with screwed or riveted-pin slip joints as shown and shall conform to the requirements of paragraph 9-19.

(b) Payment. -Payment for furnishing and installing handrailing, will be made at the contract unit price per linear foot for "Handrailing; Steel Pipe" for the size and type required. Measurement for payment will be made along the top rail between centers of supports. The contract price shall include all fittings, embedded supports, expansion and anchor bolts necessary for installation, and painting as specified in Section X.

### 12-02. LADDERS.

(a) General. -Ladders with required and necessary fittings and anchor bolts shall be furnished and installed at the spillway piers, and other places as designated on the drawings or directed by the contracting officer. Ladders shall be of sizes as shown on the drawings and shall be of structural steel conforming to the requirements of paragraph 9-04. Hoop ladder guards shall be provided when shown on the drawings or directed by the contracting officer.

(b) Payment. -Payment for furnishing, installing, and painting all ladders, guards, and anchor bolts will be made at the contract unit price per pound for "Steel Erection; Structural."

### 12-03. SAFETY TREADS.

(a) General. -Safety treads shall be furnished and installed by the contractor in all concrete stairs as shown on the drawings. Safety treads shall conform to the requirements of paragraph 9-03.

(b) Payment. -Payment for furnishing and installing safety treads complete with anchorages will be made at the contract unit price per pound for "Safety Treads."

### 12-04. ELECTRICAL CONDUIT SYSTEM.

(a) General. -Only that portion of the electrical conduit system which will be embedded in concrete or as may be directed by the contracting officer will be installed under this contract. This will include conduit for roadway lighting, branches to heaters, flood lights and crane circuits, and embedded feeders.

(b) Workmanship. -Rigid metal conduit shall be installed in accordance with the requirements of the National Electric Code and to the satisfaction of the contracting officer. Ends of metal conduit shall be reamed to remove rough edges and burrs, and all joints between lenghts of conduit, and at switches, junction boxes and fittings shall be watertight and shall provide electrical continuity of the conduit run so that it can be effectively grounded. Open conduit ends shall be capped, except when working on the run, to exclude dirt and moisture. Conduit runs shall be pitched to provide suitable drainage and all low sections of conduit runs that may trap water shall be vented for drainage in a suitable manner. Any run of conduit extending through a construction joint, or changing from an embedded to an open run, shall extend not less than the threaded length plus 1 inch past the face of the concrete. All conduit bends shall have a radius not less than that recommended by the National Electrical Code. Field bends may be used if of the proper radius and carefully made with suitable tools so that the conduit is not flattened. No threadless fittings or running thread couplings shall be used in conduit runs. All conduit terminations shall be threaded and sealed with pipe caps, couplings, and pipe plugs or conduit bushings and metal discs, before concreting operations are commenced.

(c) Expansion Joints. -Where conduit runs cross structural expansion joints, conduit expansion joints of standard manufacture similar or equal to Crouse-Hinds Type XJ Condulets shall be provided. Grounding jumpers shall also be provided to insure electrical continuity in accordance with the National Electric Code.

(d) Conduit. -All conduit shall be rigid metal conduit, enameled on the inside and outside, and shall conform to Federal Specification WW-C-571 dated June 6, 1933, for "Conduit; Steel, Rigid, Enameled.

(e) Conduit Fittings. -All conduit fittings shall be high test gray iron or malleable iron castings, enameled on the inside and outisde, of the types and sizes specified or indicated. They shall be approved by the National Board of Fire Underwriters.

(f) Payment . -Payment for furnishing and installation of metal conduit, including conduit fittings and supports, completely installed in place, will be made at the contract unit prices per pound for the "Conduit; Metal."

## 12-05. ELECTRICAL GROUNDING SYSTEM

(a) General. -An electrical grounding system shall be furnished and installed as shown on the drawings, for the protection of all machinery and equipment on the dam. Four ground cables shall be embedded in the concrete of the dam where directed, with 100 ft. of each cable resting on the river bed and the upper end exposed for connection to the longitudinal cables. Each embedded cable shall be of sufficient length for the complete installation and the unattached part shall be temporarily coiled and protected. No splices shall be made in any embedded gound cables.

Two exposed cables shall extend the full length of the dam and shall be supported at intervals of 10 ft. or less. Each of these longitudinal cables shall be connected to all four of the embedded ground cables in an approved manner.

(b) Cable. -Ground cable shall be standard bare stranded annealed cooper, single conductor cable. The size shall be as shown on the drawings.

(c) Payment. -Payment for furnishing and installing the grounding system in place as required, including all necessary conduit nipples, bushings and protective housings, will be made at the contract lump sum price for "Electrical Grounding System."

## 12-06. CONCRETE STOPLOGS.

(a) General. -Concrete stoplogs shall be constructed and installed in spillway bays Nos. 1 to 4 and 37 to 40 inclusive. The stoplogs shall be of the dimensions shown and have the reinforcement, steel plates, lifting device, and other details as shown on the drawing. The concrete shall be as specified in Section V for Class A concrete. The stoplogs shall be constructed true to the lines shown so as to bear properly on each other and on the guide rails. The stoplogs shall be lifted only by the lifting devices provided. In lifting the stoplogs the contractor shall use shackles or clevises and pins of the proper size to fit the lifting plates and holes.

(b) Payment. -Payment for constructing and installing concrete stoplogs will be made at the contract lump sum price for "Concrete Stoplogs," which price shall include the cost of furnishing all material (except cement and reinforcing steel which will be furnished by the Government), constructing, handling, and installing the concrete stoplogs, and all work connected therewith.

## 12-07. HATCH COVERS.

(a) General. -Covers shall be provided for the hatch openings of the gate repair and storage chambers in the east bulkhead and for the service hatch openings in both bulkheads. The hatch covers shall be constructed of reinforced concrete. Class "A", and structural steel as detailed on the drawings.

(b) Payment. -Payment for constructing, installing, and painting the hatch covers will be made at the respective contract unit prices for "Concrete; Class "A", "Steel Erection; Concrete Reinforcing" and "Steel Erection; Structural."

## 12-08. SUMP PUMP DRAINS.

(a) General.-Flanged cast iron pipe shall be furnished and installed in the bulkheads adjacent to the drainage sumps, as shown on the drawings. Pipe shall be Class 150, with American Standard flanges and flanged fittings (see paragraph 9-21). All pipe and fittings shall be completely coated inside and out with standard coal-tar pitch varnish. Joints shall be made with composition gaskets approved by the contracting officer and shall be securely bolted. Bolts and nuts shall conform to the requirements of paragraph 9-23. All piping shall be securely supported.

(b) Payment. -Payment for furnishing and installing sump pump drains will be made at the contract unit price for "Pipe; Cast Iron."

## 12-09. FLOOR AND DECK DRAINS.

(a) Floor Drains.-Cast iron floor drains shall be furnished and installed in the floors of the various chambers of the bulkheads, draining into the sump through cast iron bell and spigot pipe (see paragraph 9-21), embedded in the concrete, as shown on the drawings. Drain pipe shall pitch toward sump not less than ¼ inch per foot, and shall be provided with wye branches and screwed brass plugs for cleanouts. Flexible expansion joints shall be made in the pipe lines adjacent to expansion joints in the dam, as indicated on the drawings, by the use of cast iron sleeve type couplings similar and equal to Type 53 made by the S. R. Dresser Mfg. Co. of Bradford, Pa.

(b) Deck Drains. - Cast iron drains shall be installed in the decks of the bulkheads, connected to wrought iron or cast iron pipe as shown on the drawings, draining into the river at the upstream or downstream face of the bulkhead.

(c) Payment. - Payment for furnishing and installing floor and deck drains and drain pipes, including fittings, will be made at the respective contract unit prices for "Iron; Case, "Pipe; Cast Iron," and "Pipe; Wrought Iron."

12-10. BRONZE STAGE GAUGES.

(a) General. - Bronze stage gauges consisting of cast bronze numerals and markers shall be furnished and installed on each bulkhead as shown on the drawings. The bronze shall conform to the requirements of paragraph 9-10. The numerals and markers shall be of the type and size and contain anchors essentially as shown on the drawings, except that commercial numerals may be furnished subject to the approval of the contracting officer. The numerals and markers shall be installed in such a manner that the face of the metal is flush with the face of the concrete and shall be accurately placed on the form and securely attached thereto, by any method the contractor may elect, subject to the approval of the contracting officer. The numerals and markers shall not be displaced during concreting operations. After removal of the forms, the contractor shall polish the faces of the numerals and markers and smooth finish the concrete adjacent to the metal.

(b) Payment. - Payment for furnishing, installing, and polishing bronze stage gauges will be made at the contract unit price per pound for "Bronze; Castings."

12-11. SUMP PUMP SUPPORTS.

(a) General. - Structural steel supports with grating floor shall be furnished and installed for supporting the pumps and motors at the drainage sumps in the bulkheads, as shown on the drawings.

(b) Payment. - Payment for furnishing and installing sump pump supports will be included in the contract unit price per pound for "Steel; Structural, Miscellaneous.

12-12. GUARD CHAINS AND MISCELLANEOUS BOLTS AND FORGINGS.

(a) General. - Forged steel guard chains complete with anchors and hooks as described in paragraph 9-26 shall be provided and installed at openings in handrailing and at other locations as shown on the drawings or directed by the contracting officer. Miscellaneous bolts and forgings shall be furnished and installed as shown on the drawings or as may be required by the contracting officer. Chains and other forgings not embedded in concrete shall be painted in accordance with the requirements of Section X.

(b) Payment. - Payment for furnishing, installing, and painting guard chains, guard chain hooks and anchors, and miscellaneous bolts and forgings for which payment is not otherwise provided will be made at the contract unit price per pound for "Steel Forgings; Miscellaneous."

## 12-13. BRAZING, FIELD RIVETING, AND FIELD WELDING.

(a) Brazing. -The surface at the joint shall first be thoroughly cleaned and the parts firmly clamped together. The brazing shall be done in such a way as to prevent oxidation during the process, preferably by using a calcined flux. The speltor shall be a copper-zinc alloy composed of 64% copper and 36% zinc.

(b) Field Riveting. -The rivet sizes shown on the drawings are the actual size of the cold rivets before heating. All connections shall be accurately and securely fitted up before the rivets are driven. Drifting done during assembling shall be only such as to bring the parts into position and not sufficient to enlarge the holes or distort the metal. Rivets shall be driven with a pneumatic hammer and a pneumatic bucker shall be used where practicable. Rivets shall be heated uniformly to a light cherry-red color and driven while hot. They shall not be burned or over-heated. When heated and ready for driving they shall be free from slag, scale, and other adhering matter. When driven they shall completly fill the holes. Heads shall be of an approved shape, of full and equal sizes, free from fins, concentric with the shanks, shall have full contact with the surface of the member, and shall grip the assembled parts firmly together. Unless otherwise specified or authorized, counter-sunk rivets shall be chipped or ground flush. Loose, burned, badly formed, or otherwise defective rivets shall be replaced. In removing defective rivets care shall be taken not to injure the adjacent metal and, if necessary, they shall be drilled out. Calking or recupping of defective rivets will not be permitted. In any case when a cold rivet of the size specified cannot be entered with light tapping, the hole shall be reamed with a twist reamer.

(c) Field Welding. -Welding will be permitted only where specifically called for on the drawings or as authorized by the contracting officer. All pieces to be welded shall be free from rust, paint, or other foreign matter for a distance of not less than ½ inch back from the welding edge.

All welding shall be done by competent welders by the electric arc method, using a process which will exclude the atmosphere from the molden metal. The welding shall be done in a manner that will produce complete fusion with the parent metal. Unless otherwise specified, the applicable current codes, specifications, and recommended practices of the American Welding Society shall govern all welding work. Certification of welders will not be required unless, in the opinion of the contracting officer, inspection of the work indicates that unsatisfactory welds are being produced.

Field welding on gates will, in general, be only for the purpose of calking joints or plugging holes. However, welding may be required or allowed by the contracting officer for certain other minor details.

Deposited weld metal shall have corrosion, physical and chemical characteristics consistent with those of the base metal. Coated welding rods, if used, shall be of the heavily coated type.

## 12-14. PLUMBING.

(a) General. -The necessary embedded pipe and connections for the future plumbing system shall be furnished and installed as shown on the drawings. Joints in bell and spigot pipe shall be made with caulking jute, and sulphur-base joint compound approved by the contracting officer. Joints in steel or wrought iron pipe shall be threaded. Open ends of pipe shall be capped or otherwise protected to prevent clogging of the pipe or damage to the ends.

(b) Payment. -Payment for furnishing and installing plumbing under this contract will be made at the applicable contract unit price per pound for "Pipe; Cast Iron," "Pipe; Wrought Iron," or "Pipe; Black Steel, Miscellaneous," which payment shall include the cost of furnishing joint material and making pipe connections as required.

## 12-15. PARKING AREAS.

(a) General. -Parking areas shall be constructed on the earth dams near the guard houses and on each bank near the approaches to the dam where shown on the drawings or directed by the contracting officer.

(b) Sub-grade. -Sub-grade for the parking areas on the earth dams shall be the compacted fill of the earth dams left one foot below the finished grade of the parking area. Sub-grade for the parking areas on the banks of the river shall be waste rock and earth from the required excavation for the dam, which shall be graded uniformly to one foot below the finished grade of the parking areas and compacted by rollers as described in paragraph 4-04 (f).

(c) Gravel Surfacing. -Bank run sand and gravel complying with the specifications for sand and gravel backing (paragraph 4-05(b) shall be placed in two 6-inch layers and each layer compacted to provide a firm surface to the satisfaction of the contracting officer. The gravel for the upper course shall be free from stones greater than 3 inches in diameter. After the upper course has been compacted, depressions 1 inch or more in depth shall be filled and recompacted to provide a smooth firm surface sloped for good surface drainage.

(d) Guard Rail. -A two guard rail shall be installed at the sides of the parking areas as shown on the plans. The guard rail shall be constructed in accordance with the requirements of paragraph 12-16.

(e) Payment. -Payment for gravel surfacing for parking areas will be made at the contract unit price per square yard for "Rolled Gravel Surface," which price shall include the cost of preparing the sub-grade, furnishing, placing, and compacting the gravel in two courses, and all other expenses incidental thereto. No payment will be made for placing material below the sub-grade of the parking areas on the river banks as waste material from the required excavation for the dam is to be disposed of in those areas. Payment for guard rails is to be made at the contract unit price per lineal foot for "Highway Guard Rail."

## 12-16. HIGHWAY GUARD RAIL.

(a) General. -A two wire guard rail shall be installed along the embankments and at the sides of parking areas, as shown on the drawings or as directed by the contracting officer. Posts shall be 8-inch diameter fir, sound and free from defects. All posts shall be pressure creosote treated for the full length in accordance with the requirements of Federal Specification TT-W-571a for "Wood-Preservative; Preservative-Treatment" as shown in Table I for empty-cell treatment of structural timber for the size and material indicated. Creosote shall conform to Federal Specification TT-W-566. All holes shall be drilled before creosoting. Wire rope shall conform to Federal Specification RR-R-571 and amendment 4 dated January 1941, for "Rope, Wire," for Type III, 3 by 7, annealed steel, galvanized wire rope. Anchor rods, clamp bolts, and all metal parts and fittings shall be galvanized iron. The posts shall be set plumb, evenly spaced, and true to lines and grades as indicated on the drawings. The wire shall be put through hook bolts or through posts as required, and shall be drawn taut and fastened securely on both ends as indicated. Where necessary, cables shall be neatly and carefully spliced or joined by means of metal sockets into which the cable's ends are securely fastened by pouring full of molten zinc. Deadman type anchors shall be provided at the ends, and at intervals of 600 feet as indicated on the drawings.

(b) Payment. -Payment for furnishing and installing guard rail, complete, will be made at the contract unit price per lineal foot for "Highway Guard Rail." Measurement will be made from center to center of end posts plus an allowance of 15 feet for each anchorage.

## 12-17. ROOFS.

(a) General. -The roofs of the guardhouses shall consist of a Class "A" reinforced concrete slab with a wood float finish and shall be sloped to drain as shown on the drawings, and shall have a 4"x4" fillet strip of concrete around the perimeter of the roof. The surface of the concrete shall be smooth and free of all loose material and shall be dry before application of roof finish.

(b) Roof Surfacing. -Four layers of 15-pound asphalt-saturated 32 inches wide, shall be placed on top of the concrete, each laid in a heavy mopped coat of pitch and lapping the layer below by 24 ½ inches, and extending to the top edge of the 4"x4" fillet strip, see paragraphs 9-30 and 9-31. The roof shall then be covered with not less than 400 pounds per 100 square feet of washed and screened gravel of approved size, embedded in a heavy uniform coat of hot pitch. No work shall be executed when the temperature is less than 50°F. The completed roof shall be similar and equal to roofs constructed in conformity with Barrett Type AA specifications.

(c) Flashing. -Flashing shall consist of four layers of 15-pound asphalt-saturated felt, each laid in flashing pitch and a finish layer of mineral surface roofing felt, the upper edges of all to be embedded in a suitable flashing groove and cemented in place with pitch of a suitable character.

(d) Drains. -A sump type cast iron roof drain with dome type strainer, similiar and equal in quality to Type 413S of Josam Manufacturing Company with gravel stop and clamping ring, shall be installed in each roof. A 3-inch wrought iron pipe shall be installed and connected to the roof drain as shown on the drawings.

(e) Payment. -Payment for furnishing and installing roof surfacing complete, flashing, and roof drains, will be made at the respective contract unit prices for "Roof Surfacing," "Roof Drains," and "Pipe; Wrought Iron."

## 12-18. DOORS AND WINDOWS.

(a) Doors and Frames. -Steel doors and frames shall be installed in the guard houses and in the compartments of the bulkheads as shown on the drawings.

(1) General. -Doors and frames shall be of the hollow steel type, with steel panels in accordance with details and sizes shown on the drawings, and shall be of the first-class materials and workmanship in every way. The thickness of the metal for the various doors and frames shall be as shown on the drawings. Corners shall be mitered, welded, and ground smooth to produce indisernible joints. Frames and doors shall be reinforced and provided with recesses, cutouts, drilled or tapped holes etc., as required to suit the

hardware applied. The parts of the doors shall be so constructed as to be proof against water entering and being retained inside the tubular rails and stiles. Doors shall have beveled edges on the lock stiles. The frames shall be securely anchored to the masonry. Doors and frames shall be set plumb and square and the doors shall fit perfectly. All exterior door frames shall be caulked against the masonry with an approved caulking compound, "Vulcatex" or equal, of color to match concrete.

(2) Weather Stripping and Thresholds. - All exterior doors shall be rendered thoroughly weather-tight by the installation of brass threshold and spring bronze weather stripping, as approved by the contracting officer. At the bottom of the doors the weather stripping shall be of a pattern made to interlock with the threshold. The weather stripping shall be held in place with hard metal screws and so designed and installed as to offer no reduction in the effective size of the door opening.

(3) Hardware. - Finish hardware shall be of heavy construction and suitable for the doors on which it is to be used, and shall conform to requirements of paragraph 9-28. All hardware shall be fitted at the factory in a neat and workmanlike manner. Hinges shall be of wrought bronze with ball bearings All doors shall have cylinder locks with 5 pin tumblers, with four keys for each lock, and with four master keys, keyed to all locks. Double doors shall have top and bottom flush bolts. Exterior doors shall be provided with door stops with hooks, bumpers, keepers, and door closers Type 3000, size IV, Federal Specification FF-H-121a. Each screen door shall have brass or bronze hinges, latch with handle or knob and a screen door closer and check.

(b) Windows. - Windows in the guard houses and toilet rooms shall be steel sash of the casement type and windows in the bulkhead compartments shall be of the horizontally pivoted type, similar and equal to those manufactured by the Detroit Steel Products Company, and shall be provided with suitable hinges, catches, and handles for their proper operation; the horizontally pivoted windows shall be provided with chains for operation from the floor. The windows shall be set into place with expansion plugs or be grouted as shown on the drawings, and caulked from the outside with an elastic caulking compound similar and equal to "Vulcatex" of a color to blend with the concrete.

(c) Glazing. - All window sash shall be glazed with Type B, double strength, "A" quality glass prior to the application of the finish paint coats. Glass shall be set from the outside for casement windows and from the inside for horizontally pivoted windows and shall be embedded in special steel sash putty to avoid direct contact with steel. Glass shall be held in place in the window sash with spring steel wire glazing clips. The putty shall be cut flush and neatly pointed. After completion of painting, the glass shall be cleaned of all paint, putty, and other marks in a manner satisfactory to the contracting officer.

(d) Screens. - Metal screens shall be installed at all windows and at the doors in the guard houses.

(1) General. - The frames shall be of steel tubular construction, thoroughly welded and reinforced at all corners so as to prevent water entering the tubes. Frames shall be of such size as to give sufficient stiffness and rigidity to hold the wire cloth tight. All screens shall be so constructed as to cover the opening as a single unit, without the use of separate filler plates or other loose pieces. Wire screen cloth shall be of copper or bronze wire, with 16 meshes to the inch, and shall be neatly and securely attached to the frame by metal splines which shall be so constructed as to be easily removable for rewiring.

(2) Window Screens. - Window screen frames shall be of not less than No. 24 U. S. Standard Gage Steel. They shall be complete with all

necessary bolts, clips, and catches. Screens for windows in the bulkhead compartments shall be removable from the inside.

(3) Screen Doors. - Screen door frames shall be of not less than No. 18 U. S. Standard Gage Steel, and shall have 2 tubular cross rails besides the top and bottom rails. One shall be located approximately 12 inches from the bottom and the other opposite the middle rail of the steel door. The space between the 2 bottom cross rails shall be filled with a metal kick plate of not less than No. 18 gage. The wire screen cloth below the middle rail shall be protected by an interlocked bronze ribbon grille. Hardware shall be as specified in paragraph 12-18(a)(3).

(e) Payment.

(1) Doors. - Payment for furnishing, installing, and painting steel doors complete with frames, screen doors, hardware, weather stripping, and thresholds as required will be made at the contract unit price per pound for "Doors; Steel."

(2) Windows. - Payment for furnishing, installing, glazing, and painting steel sash complete with window screens, hardware, and all necessary appurtenances will be made at the contract unit price per pound for "Windows; Steel."

### 12-19. FLAGPOLES.

(a) General. - Two tapered steel tubing flagpoles similar and equal to "Conetapered 'C' Type, heavy," as manufactured by the Pole and Tube Works, Inc., Newark, New Jersey, shall be furnished and installed complete, one on each guard house, as shown on the drawings. Each flagpole shall be fitted with a gold leaf covered copperball, ball-bearing revolving bronze truck and ½-inch flexible steel rope halyards with flag snaps. Bronze cleats shall be mounted on the walls of the guard houses for tying the halyards. Mountings which attach the flagpoles to the masonry shall be of cast bronze. The flagpoles shall be painted in accordance with the requirements of Section X.

(b) Payment. - Payment for furnishing and installing flagpoles complete, including painting, will be made at the contract unit price each for "Flagpoles."

Invitation No.

## STANDARD GOVERNMENT FORM OF BID
(Construction Contract)

---

(Place) ____________________

(Date) ____________________

To: The District Engineer,
U. S. Engineer Office,
Massena, New York.

1. In compliance with your invitation for bids dated ____________________ and subject to all the conditions thereof, the undersigned,

____________________________________________________________,

a corporation organized and existing under the laws of the State of

____________________________________________________________,

a partnership consisting of ________________________________________

____________________________________________________________

____________________________________________________________

or an individual trading as ________________________________________

____________________________________________________________

of the city of ____________________________________________________

hereby proposes to furnish all plant, labor, and materials and perform all work required for the construction of the Iroquois Dam complete, at the locations shown and to the extent indicated, in strict accordance with the specifications, schedules, and drawings, for the consideration of the following prices:

### IROQUOIS DAM

### SCHEDULE OF BID ITEMS

| Item No. | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Excavation; Cofferdam | Cu.Yd. | 107,400 | $_____ | $_______ |
| 2 | Timber Cribs in Place | M.B.M. | 6,200 | $_____ | $_______ |

## IROQUOIS DAM

## SCHEDULE OF BID ITEMS (continued)

| Item No. | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 3 | Crib Sheathing(Bulkheads) | Sq. Ft. | 16,000 | $____ | $______ |
| 4 | Steel Sheet Piling in Place | Sq. Ft. | 64,300 | $____ | $______ |
| 5 | Crib Fill | Cu. Yd. | 155,200 | $____ | $______ |
| 6 | Earth Fill; Cofferdams | Cu. Yd. | 298,500 | $____ | $______ |
| 7 | Rock Fill; Cofferdams | Cu. Yd. | 106,700 | $____ | $______ |
| 8 | Riprap; Cofferdams | Cu. Yd. | 20,800 | $____ | $______ |
| 9 | Derrick Stone; Cofferdams | Ton | 5,000 | $____ | $______ |
| 10 | Cofferdam Removal | Cu. Yd. | 569,000 | $____ | $______ |
| 11 | Unwatering Cofferdams | Acre Ft. | 25,000 | $____ | $______ |
| 12 | Excavation; Common, Dam | Cu. Yd. | 657,200 | $____ | $______ |
| 13 | Excavation; Rock, Dam | Cu. Yd. | 32,000 | $____ | $______ |
| 14 | Excavation; Borrow | Cu. Yd. | 100,000 | $____ | $______ |
| 15 | Excavation; Common, Canal | Cu. Yd. | 2,412,000 | $____ | $______ |
| 16 | Excavation; Rock, Canal | Cu. Yd. | 928,000 | $____ | $______ |
| 17 | Line Drilling | Sq. Ft. | 45,000 | $____ | $______ |
| 18 | Drilling 3-inch Exploratory Holes | Lin Ft. | 15,000 | $____ | $______ |
| 19 | Drilling 6-inch Concrete Cores | Lin Ft. | 1,000 | $____ | $______ |
| 20 | Drilling Foundation Grout Holes in Rock | Lin Ft. | 10,000 | $____ | $______ |
| 21 | Drilling Foundation Grout Holes in Concrete | Lin Ft. | 2,000 | $____ | $______ |
| 22 | Core Boxes | Each | 200 | $____ | $______ |
| 23 | Providing Pressure Grouting Equipment | Sum- | Job | $____ | $______ |
| 24 | Pressure Grouting | Cu. Ft. | 10,000 | $____ | $______ |
| 25 | Rock Flour in Grout | Cu. Ft. | 1,500 | $____ | $______ |
| 26 | Sand in Grout | Cu. Ft. | 1,500 | $____ | $______ |
| 27 | Earth Fill; Compacted | Cu. Yd. | 205,000 | $____ | $______ |

SCHEDULE (continued)

| Item No. | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 28 | Additional Compaction | Square (100 sf) | 50,000 | $____ | $______ |
| 29 | Sand and Gravel Backing | Cu. Yd. | 6,500 | $____ | $______ |
| 30 | Riprap, Dumped; Class A | Cu. Yd. | 6,500 | $____ | $______ |
| 31 | Riprap, Dumped; Class B | Cu. Yd. | 8,900 | $____ | $______ |
| 32 | Rock Fill; Random | Cu. Yd. | 50,000 | $____ | $______ |
| 33 | Rolled Gravel Surface | Sq. Yd. | 23,000 | $____ | $______ |
| 34 | Seeded Topsoil | Acre | 2 | $____ | $______ |
| 35 | Seeding | Acre | 2 | $____ | $______ |
| 36 | Concrete; Class A; Natural Sand Crushed Stone Sand | Cu. Yd. | 3,500 | $____ | $______ |
| 37 | Concrete; Class B: Natural Sand Crushed Stone Sand | Cu. Yd. | 61,000 | $____ | $______ |
| 38 | Concrete; Class C; Natural Sand Crushed Stone Sand | Cu. Yd. | 179,000 | $____ | $______ |
| 39 | Concrete Stoplogs | Sum | Job | $____ | $______ |
| 40 | Special Bituminous Filler Type C | Cu. Ft. | 170 | $____ | $______ |
| 41 | Steel Erection; Concrete Reinforcing | Lbs. | 6,000,000 | $____ | $______ |
| 42 | Steel Erection; Structural | Lbs. | 6,800,000 | $____ | $______ |
| 43 | Steel Rails; Placing | Lbs. | 381,000 | $____ | $______ |
| 44 | Spillway Gates; Erection | Lbs. | 22,600,000 | $____ | $______ |
| 45 | Gantry Cranes; Erection | Sum | Job | $____ | $______ |
| 46 | Steel Forgings; Miscellaneous | Lbs. | 2,500 | $____ | $______ |
| 47 | Steel; Structural, Miscellaneous | Lbs. | 5,000 | $____ | $______ |
| 48 | Iron; Cast | Lbs. | 20,000 | $____ | $______ |
| 49 | Pipe; Cast Iron | Lbs. | 39,000 | $____ | $______ |
| 50 | Pipe; Wrought Iron | Lbs. | 2,000 | $____ | $______ |
| 51 | Pipe; Black Steel | Lbs. | 2,000 | $____ | $______ |

SCHEDULE (continued)

| Item No. | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 52 | Pipe; Concrete Halved | LinFt. | 360 | $_____ | $______ |
| 53 | Bronze Castings | Lbs. | 2,700 | $_____ | $______ |
| 54 | Copper; Sheet | Lbs. | 500 | $_____ | $______ |
| 55 | Corrugated Iron; Water Stop | Lbs. | 4,200 | $_____ | $______ |
| 56 | Doors; Steel | Lbs. | 700 | $_____ | $______ |
| 57 | Windows; Steel | Lbs. | 3,600 | $_____ | $______ |
| 58 | Highway Guard Rail | Linft. | 2,600 | $_____ | $______ |
| 59 | Bridge Guard Rail | LinFt. | 2,600 | $_____ | $______ |
| 60 | Handrailing; Steel Pipe 2" | LinFt. | 9,200 | $_____ | $______ |
| 61 | Handrailing; Steel Pipe 1½" | LinFt. | 300 | $_____ | $______ |
| 62 | Safety Treads | Lbs. | 1,200 | $_____ | $______ |
| 63 | Roof Drains | Each | 2 | $_____ | $______ |
| 64 | Roof Surfacing | square (100sf) | 4 | $_____ | $______ |
| 65 | Flagpoles | Each | 2 | $_____ | $______ |
| 66 | Conduit, Metal | Lbs. | 12,000 | $_____ | $______ |
| 67 | Electric Grounding System | Sum | Job | $_____ | $______ |
| 68 | Field Office | Sum | Job | $_____ | $______ |
| 69 | Field Office Extension | Sum | Job | $_____ | $______ |

NOTES: (a) All amounts and totals given above will be subject to verification by the United States. In case of variation between unit bid price and totals shown by bidder, the unit price will be considered to be his bid.

(b) All bids must be for the entire work and must have each blank space filled in.

(c) The quantities of each item of the bid, as finally ascertained at the close of the contract, in the units given and the unit prices of the several items stated by the bidder in the accepted bid, will determine the total payments to accrue under the contract. The unit price bid for each item must allow for all collateral or indirect cost connected with it.

2. EXPERIENCE. (See Invitation for Bids, paragraph 16.)

3. STATEMENT ESTABLISHING PERMANENT PLACE OF BUSINESS AND FINANCIAL STATUS. (See Invitation for Bids.)

4. PLANT TO BE USED ON THE WORK. (See Invitation for Bids and paragraph 1-20 of the specifications.)

(a) Earthwork.

(1) Excavating Equipment.

| No. | Type | Manufacturer | Capacity | Age | Condition |
|---|---|---|---|---|---|
| | | | | | |
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(2) Transporting Equipment.

| No. | Type | Manufacturer | Capacity | Age | Condition |
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(3) Embankment Equipment.

(a) Spreading and Rolling Equipment.

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(b) Pumping and Watering Equipment.

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### (b) Pumping and Watering Equipment. (continued)

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### (b) Concrete.

#### (1) Batching Equipment.

| No. | Type | Manufacturer | Capacity | Age | Condition |
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#### (2) Transporting Equipment.

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#### (3) Miscellaneous Equipment.

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### (c) Drilling Equipment.

| No. | Type | Manufacturer | Capacity | Age | Condition |
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### (d) Grouting Equipment.

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### (e) Compressed Air Equipment.

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(f) Pumping Equipment.

| No. | Type | Manufacturer | Capacity | Age | Condition |
|---|---|---|---|---|---|
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(g) Miscellaneous Equipment.

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5. PLANT LAY-OUT (See Invitation for Bids). - The undersigned has attached herewith the plant lay-out prescribed in the Invitation for Bids.

6. PROGRESS CHARTS (See Invitation for Bids). - The undersigned has attached herewith the progress charts prescribed in the Invitation for Bids.

7. It is hereby warranted that in the event award is made to the undersigned there will be used in the performance of the work covered by the contract only such unmanufactured articles, materials, and supplies as have been mined or produced in the United States, and only such manufactured articles, materials, and supplies as have been manufactured in the United States substantially all from articles, materials, or supplies mined, produced, or manufactured, as the case may be, in the United States except as noted below or otherwise indicated in this bid or authorized in the specifications.

8. The undersigned agrees, upon receipt of written notice of the acceptance of this bid within ____ days after the date of opening of the bids, to execute the standard form of Government contract, in accordance with the bid as accepted, and give performance and payment bonds, with good and sufficient surety or sureties, for the faithful performance of the contract, and for the protection of all persons supplying labor and materials in the prosecution of the work, within ______ days after the prescribed forms are presented

for signature.

9. The undersigned agrees to begin the work within _____ calendar days after date of receipt of notice to proceed, and complete it within _____ calendar days after date of receipt of said notice to proceed.

________________________________
(Bidder)

By ______________________________
(Name and Title)

________________________________
(Business Address)

NOTE: Read Standard Government Instructions to Bidders before preparing this bid.

# PART TWO

# IROQUOIS DAM

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## PURCHASE SPECIFICATIONS

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a. Structural Steel and Reinforcing Steel.

b. Spillway Gates.

c. Gantry Cranes.

# NOTE

Due to lack of time and the present uncertainty as to final construction and shipping schedules and the final contract form desired, only the sections dealing with technical requirements for the furnishing of materials and equipment have been included in each specification. It is intended that the general provisions of the contract, in each case, will be included in Section I which has been purposely omitted.

# IROQUOIS DAM

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Specifications

For

STRUCTURAL STEEL & REINFORCING STEEL

## SECTION II - REQUIREMENTS

2-01. MATERIAL REQUIRED. - The material required under this contract consists of the following items:

(a) Gate guide towers for all piers and for the spillway ends of the east and west bulkheads, including sills, heater casings, and the structural supports for the dogging equipment; but not including track and guide rails, dogging equipment or heaters.

(b) Pier nose armor for all piers and for the spillway ends of the east and west bulkheads.

(c) Crane runway girders for the 40 spans of the spillway.

(d) Highway bridge steel for the 40 spans of the spillway and for the east and west bulkheads.

(e) Steel for all construction and expansion joints in the spillway deck and in the east and west bulkheads.

(f) Crane runway rails from the east end of the east bulkhead to the east end of the west bulkhead, including rail clips, splice bars, bolts and other necessary appurtenances.

(g) The enclosure for the crane current collector bars from the east end of the east bulkhead to the east end of the west bulkhead.

(h) Ladders and platforms at each gate slot for all gate openings.

(i) Miscellaneous items of structural steel, including the gantry crane stops at the ends of the runway, sump-pump supports, gate guide steel in the gate repair chamber, temporary foot-bridges on the piers, and other items on the dam as directed by the contracting officer.

(j) Reinforcing steel for the east and west bulkheads and for the spillway section.

2-02. SCHEDULE A. - Schedule A covers the furnishing of all items from (a) to (i) inclusive as specified in paragraph 2-01, and including all necessary appurtenances such as bolts, anchors and pipe sleeves.

2-03. SCHEDULE B. - Schedule B covers the furnishing of all reinforcing steel as specified in paragraph 2-01, item (j).

2-04. COORDINATION OF DESIGNS. - The contractor shall coordinate his designs and detailed drawings with those of related structures by means of drawings or information which will be furnished by the contracting officer.

Any other information which is necessary for furnishing the required materials, and which is at present lacking in the drawings or specifications, will be furnished by the contracting officer by means of later detailed drawings or otherwise.

Holes which are to be used for connections of equipment not furnished by the contractor shall be drilled or reamed to metal template furnished by the contracting officer or made from information given by him; or drilled or reamed with parts assembled. All templates shall be and remain the property of the Government.

## SECTION III - UNIT STRESSES

3-01. STRUCTURAL CARBON STEEL. - The unit stresses in structural carbon steel shall not exceed those corresponding to an 18,000 pound per square inch base as specified in the American Institute of Steel Construction's "Specification for the design, Fabrication and Erection of Structural Steel for Buildings" as revised January, 1934.

3-02. STRUCTURAL SILICON STEEL. - The unit stresses in structural silicon steel shall not exceed those corresponding to a 24,000 pound per square inch base.

3-03. WELDS. - The unit stresses in welds shall not exceed the following:

| | | |
|---|---|---|
| Shear . . . . . . . . . . . . . | 11,300 | lb. per sq. in. |
| Tension . . . . . . . . . . . . | 13,000 | " " " " |
| Compression (on butt welds) . | 15,000 | " " " " |

## SECTION IV - DESIGN LOADS

4-01. GATE GUIDE TOWERS. - The towers shall be designed to withstand the maximum loading conditions during construction and, after completion of the piers, to transmit the maximum loads from the track rails and from the gate dogs to the pier concrete. Each gate dog grillage, which is part of the towers, shall be designed to support a load of 287,500 pounds at the dog seat and to distribute the resulting reaction from the dog casting through the bearing pad, pivot pin and supporting beams to the pier.

4-02. CRANE RUNWAY GIRDERS.

(a) Loading. - Each girder shall be designed for the moving loads from one four-wheel crane truck with wheels spaced 3'-4'-3' on centers, in addition to the deal load of the girder. The static vertical load per wheel shall be taken as 80,000 pounds and shall be increased 25% for impact allowance.

(b) Camber. - The girders shall be cambered an amount equal to the maximum computed deflection due to the dead load plus one-half of the live load.

4-03. HIGHWAY BRIDGE STEEL.

(a) Loading. - The highway steel shall be designed for a H-20 truck loading as specified by the American Association of State Highway Officials.

(b) Camber. - The highway bridge girders shall be cambered an amount equal to the maximum computed deflection due to the dead load of steel and concrete. The weight of concrete for this purpose shall be assumed as 155 pounds per cubic foot, with no allowance for minor openings.

4-04. CRANE RAILS. - The crane rails and anchors shall be designed for the maximum vertical and horizontal loads from the crane truck wheels, with the crane in static or operating condition. The horizontal loads on the rail head shall be assumed as 20% of the vertical loads.

4-05. PLATFORMS AND FOOT-BRIDGES. - The platforms and foot-bridges shall be designed for a live load of 200 pounds per square foot over the entire area.

4-06. GANTRY CRANE STOPS. - The gantry crane stops shall be designed for a horizontal load resulting from collision of the loaded gantry crane running at full speed with power off. 75% of the total load shall be applied at each stop at the elevation of the crane bumper. In computing the horizontal load, the speed of the crane shall be assumed as reduced from full speed to zero within a distance of travel equal to the maximum movement of the bumper plunger on the crane truck.

## SECTION V - STRUCTURAL DETAILS

5-01. General. - The guide towers, pier nose armor, crane runway girders, highway bridge girders and bracing, and the construction and expansion joint details shall be of structural steel shapes and plates. Shop connections shall, in general, be riveted or welded and field connections shall be riveted or bolted as indicated on the drawings or as approved by the contracting officer. Webs of beams and channels shall be not less than 1/4 inch thick. All other structural material except fillers shall be not less than 3/8 inch thick. Except as otherwise specified or shown on the drawings, the design shall be in accordance with the American Institute of Steel Construction's "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings" as revised January, 1936.

5-02. GATE GUIDE TOWERS. - In general, construction of the guide tower shall be as shown on the Government's drawings. Particular care shall be exercised in the design that the required tolerances and clearances are maintained and that the towers may be accurately plumbed and held in true position in the field while concrete is being poured around them. Shop connections shall be welded, but the grillages for supporting the gate dogs shall be riveted. The pin plates shall be machined accurately to the required bevel and the holes reamed for a loose fit on the pin after riveting the entire grillage assembly. Tower splices shall be milled and shall be bolted with turned bolts in reamed holes.

5-03. CRANE RUNWAY GIRDERS. - The crane runway girders shall be of the double web type with top cover plate and diaphragms as shown on the Government's drawings. They shall be of riveted construction and shall be proportioned by the moment of inertia of the net section. Holes for the crane rail anchor bolts shall be sub-punched and reamed to template; and all details shall be such that the girders may be accurately aligned and the crane track gauge on the completed runway accurately set and maintained. End bearing details shall adequately provide for movement due to temperature changes. All girders shall be completely shop fabricated and shopped in one piece except for end bearings. Provision shall be made for attachment of all railings, ladders, conduit boxes, current collector enclosures and other required fittings. The girders shall be cambered as specified in paragraph 4-02 (b).

5-04. HIGHWAY BRIDGE STEEL. - The highway bridge steel shall consist of four rolled section girders in each span, properly braced. All connections shall be riveted. End bearing details shall adequately provide for movement due to temperature changes. The girders shall be cambered as specified in paragraph 4-03 (b).

5-05. CRANE RAILS. - The rails shall be Lorain crane rails, Section No. 175-418 and shall be furnished complete with splice plates, clips, bolts and other necessary fittings. The rails shall be accurately formed to the required curvature.

5-06. LADDERS, PLATFORMS AND FOOT-BRIDGES. - Ladders, platforms and foot-bridges shall be provided at all locations shown on the drawings or required by the design. Ladders shall be not less than 14 inches wide, with 1 inch diameter rungs spaced 12 inches on centers between 2-1/2 inch by 3/8 inch side bars. The rungs shall be inserted 1/4 inch in punched holes on the side bars and welded on both sides of the side bars. The ladders shall be equipped with circular safety guards of adequate design where indicated on the drawings.

The platforms and foot-bridges shall consist of steel rolled sections with grating floor, and shall be provided with steel angle or pipe railing as required.

5-07. GANTRY CRANE STOPS. - The crane stops shall be of structural steel framing with a steel striking plate for the crane bumpers. Two stops are to be placed at each end of the crane runway, one at each end of each rail. The framing shall be designed to transmit the load specified in paragraph 4-07 from the striking plate to the bulkhead concrete. It is intended that the steel framing of the crane stops will be encased in concrete.

5-08. EXPANSION AND CONSTRUCTION JOINT STEEL. - Expansion joint steel shall consist of curb angles, with welded strap anchors, supporting heavy sliding cover plates with interlocking teeth on the roadway portion of the bridge and plates with beveled edges on the sidewalk portion. Construction joint steel shall consist of curb angles, with welded strap anchors, separated at the bottom by a bar welded on the angle on one side of the joint to provide a slot for filling with expansion joint material.

5-09. COLLECTOR BARS ENCLOSURE. - The enclosure for the collector bars shall be of plates and angles for attachment in the field to the upstream side of the upstream crane girder. There shall be a removable steel plate cover attached with bronze screws. Provision shall be made for connection of the supports for the current conductors and the design shall be such as to permit removal and replacement of the supports. Shipment shall be made in sections not to exceed about twenty feet in length.

5-10. PIER NOSE ARMOR. - Pier nose armor shall consist of heavy steel angles with welded strap anchors. At the east and west bulkheads the armor shall be of heavy plate bent to the shape of the bulkhead corner and with strap anchors welded on.

## SECTION VI - FABRICATION OF STRUCTURAL STEEL

6-01. GENERAL. - Fabrication of structural steel shall be in accordance with Section 25 of the "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings" as adopted by the American Institute of Steel Construction as revised in 1936, except as may be otherwise noted in these specifications.

Fabrication of plate girders shall be in accordance with Section V of the American Railway Engineering Association's "Specifications for Steel Railway Bridges," dated 1940.

6-02. WELDING.

(a) General. - All welding except as otherwise specified shall be done in accordance with the applicable current Codes, Specifications, and Recommended Practices of the American Welding Society.

Parts to be welded shall be rigidly held by sufficient clamps or other adequate means to keep the parts in close contact and in accurate position. Adequate precautions shall be taken to minimize locked-up stresses and distortion due to heat.

Fillet welds in sizes up to 1/4 inch shall be made in one pass, and larger welds shall be made in two or more passes. Successive beads or layers shall be uniform in thickness.

Each layer of weld metal shall be thoroughly cleaned before subsequent layers are deposited. Upon completion, each weld shall be thoroughly cleaned and brushed with wire brushes, and extraneous nodules of weld metal shall be removed by chipping.

Wherever there is danger of the assembled structure or member becoming warped or distorted by localized welding stresses, the welds shall be thoroughly peened with a pneumatic tool to relieve such stresses.

All welds shall be free from unsound metal, cracks, overlap, and feather edges. Minor imperfections in welds may be chipped out and the defect rewelded, subject to approval. Distortions due to welding or stress-relieving shall be corrected by pressing and not by blows.

Welding shall be done only by welders properly qualified in the work of the actual process employed. The contractor shall assign to each welder an identifying number, letter or symbol which shall be stamped in the metal adjacent to and at intervals of not more than three feet along all welds which he makes.

(b) Qualification of Welders. - Before beginning the production of welded work, the contractor shall furnish to the contracting officer satisfactory evidence, in the form of a certificate by a recognized testing agency or by actual demonstration, that each welder to be employed on the work of this contract has within one year of the date of this contract satisfactorily performed the qualification tests prescribed by the American Welding Society in its latest "Code for Fusion Welding and Gas Cutting in Building Construction" using the detailed procedure to be followed in actual production under this contract.

The contractor shall require any welder to repeat these tests when in the opinion of the contracting officer the work indicates a reasonable doubt of the welder's efficiency.

6-03. WORKMANSHIP. - All workmanship shall be first-class and shall be done by workmen skilled in their various trades. Tolerances fits and finish shall conform with the best modern shop practices in manufacture of finished products of a nature similar to those covered by these specifications.

6-04. SHOP ASSEMBLY. - Each guide tower shall be completely assembled in the contractor's shop prior to shipment. Each assembly will be inspected and checked by the contracting officer or by his authorized representative and any errors, omissions, or inaccuracies discovered shall be promptly corrected by the contractor. While assembled, all shipping pieces shall be so matchmarked that they may be erected in the field in the same relative position. There shall be no disassembling in preparation for shipping or for any other purpose until inspection has been made.

6-05. PREPARATION FOR SHIPMENT. - The contractor shall prepare all materials and articles for shipment in such manner as to facilitate handling and to protect them from damage in transit; and shall be responsible for and shall make good any and all damage due to improper preparation and loading for shipment. All threads and finished surfaces shall be protected as specified in Section VIII. All small parts shall be contained in properly marked boxes and each box shall contain a list showing the contents. Each shipping piece shall be marked in accordance with approved assembly drawings. Marks shall be legible and so placed as to be visible when the piece is being erected. Each piece weighing more than one ton shall have its approximate weight marked on it.

## SECTION VII - MATERIALS

### 7-01. GENERAL

(a) Materials. - All materials shall be of new and unused stock, and free from defects. Substitution of size of sections and materials from that shown on the drawings or required in the specifications shall not be made except on written approval of the contracting officer and provided that the cost to the Government shall not be increased thereby.

Materials indicated on the drawings or required in the work and not covered elsewhere in these specifications by detailed requirements, shall conform to the requirements of this section.

Any materials required which are not covered by detailed specifications herein or elsewhere in the specifications shall conform to the applicable Federal Specifications, grade and/or class as required or, in case where there are no applicable Federal Specifications, to applicable specifications of the American Society for Testing Materials (A.S.T.M.). In all other cases not specifically covered in these specifications the contractor shall furnish the highest grade commercial material or product.

(b) Inspection, Acceptance and Rejection of Materials.- All materials shall be subject at all times to inspection by the contracting officer who will select such samples in such quantities as he may deem necessary and subject the same to such tests as may be necessary to determine their qualities as herein specified, and he will accept or reject materials in accordance with the results of such test. Tests may be repeated upon arrival of the various shipments at the site of the work as may be necessary to insure the acceptance of only such materials as will comply with the provisions of the plans and specifications.

(c) Test Specimans.- Special test specimans shall be furnished by the contractor on request; and shall be of such shape and number as designated; and shall in general conform to Federal Specifications or the specifications of the American Society for Testing Materials as to shape, size, and method of testing.

(d) Mill Test Reports. - Mill test reports certified to by qualified technicians shall be furnished when required for all material entering into this work and will, in general, be the basis of acceptance or rejection of the materials. The contracting officer may, however, require of the contractor special chemical or physical tests on any part of the material if in his opinion the conditions justify such a check.

(e) Federal Specifications. - Copies of Federal Specifications referred to herein may be procured from the Superintendent of Documents, Government Printing Office, Washington, D. C., at a price of five or ten cents each. When the term: "Federal Specifications" or "A.S.T.M. Specifications" is cited, the reference shall be construed to mean the specification as modified by any amendments promulgated before the date of opening bids for the contract.

### 7-02. STRUCTURAL CARBON STEEL.

Structural carbon steel shall conform to Federal Specification QQ-S-711a for "Steel, Structural; (for) Bridges," Class A. Surface imperfections shall be remedied by arc-welding and according to Government practice. The chemical properties of the steel shall be such as to permit it to be readily welded by this process.

7-03. RIVET STEEL. -Rivet steel shall conform to Federal Specification QQ-S-711a for "Steel, Structural; (for) Bridges," Class C.

7-04. BOLTS AND NUTS.

(a) Unless otherwise specified or called for on the drawings, the material for bolts and nuts shall conform to the Standard Specification of the A.S.T.M. for "Commercial Quality Hot Rolled Bar Steels." Designation A 107-40, Grades 22, 23, 24, or 25.

(b) The material for bronze bolts and nuts shall conform to Federal Specification QQ-B-636 for "Brass, Naval; Bars, Plates, Rods, Shapes, Sheets, and Strips," Type I, half hard.

(c) The material for bolts and nuts of "high Strength steel" shall conform to the Tentative Specification of the A.S.T.M. for "Alloy-Steel Forgings for General Industrial Use," Designation A 237-40T, Class D.

7-05. STEEL RAILS. -The crane track rails shall be new, 175 pound, section 175-418, and shall conform to the Standard Specifications of the American Society for Testing Materials for "Open-Hearth Steel Girder Rails of Plain, Grooved, and Guard Types," Designation A2-27, Class A, No. 1. The rails shall be heat-treated throughout their length and cross section by heating uniformly to above the critical temperature, quenching and tempering to produce a Brinell hardness of 320 to 350. All heating, quenching and tempering shall be done with equipment which will accommodate the entire length of each piece. After heat-treatment, the rails shall be smooth on the head and the required curvature of the rail axis maintained.

7-06. SPLICE BARS. -All splice bars shall be new and shall conform to the Standard Specification of the American Society for Testing Materials for "Low-Carbon-Steel Joint Bars," Designation A3-33.

7-07. RAIL CLIPS. -Rail clips shall be either structural steel, forged steel or cast steel, in accordance with the standard practice of the contractor.

7-08. FLOOR GRATING. -Floor grating shall conform to Federal Specifications RR-G-661a for "Grating, Steel, Floor (Except for Naval Vessels)," Type I with welded cross members and of dimensions as shown on drawings.

7-09. WELD RODS AND DEPOSITED WELD METAL. -Weld rods shall be of the heavily-coated type. Deposited weld metal shall have a corrosion resistance at least equal to that of mild steel. The ultimate strength of the metal shall be not less than 60,000 pounds per square inch and the elongation in 2 inches not less than 20 per cent.

7-10. REINFORCING STEEL: CONCRETE. -Reinforcing steel shall conform to Federal Specification QQ-B-71a for "Bars; Reinforcement, (for) Concrete," Type B. Straight bars shall be Grade 2 (Intermediate, Billet Steel), Grade 4 (Hard, Billet Steel) or Grade 5 (Hard, Rail Steel). All bent bars shall be of Grade 2 (Intermediate, Billet Steel) or grade 3 (Intermediate, Car Axle Steel). The steel shall be properly identified as to grade.

## SECTION VIII- PAINTS AND PAINTING

8-01. GENERAL. - All paint, when applied, shall provide a satisfactory film and a smooth even surface, except when sand reinforced, and undercoats shall dry without excessive gloss, suitable for the proper application and adhesion of subsequent coats, as approved by the contracting officer. Where necessary, in the opinion of the inspector, to suit the conditions of surface, temperature, and weather existing at the particular time of application, the packaged paint may be thinned by the addition of not more than one pint per gallon of the proper thinner immediately prior to application, provided that in no case shall the viscosity of the paint be reduced to a point where the specified maximum coverages will be exceeded.

### 8-02. SURFACE CLEANING AND PREPARATION.

(a) Cleaning. - All ferrous surfaces to be painted shall be thoroughly cleaned of all millscale and other foreign substances to base metal by sandblasting or any other method approved by the contracting officer.

(b) Protection of Surfaces. - Care shall be taken to adequately protect all machinery parts, threads, and finished surfaces during cleaning and preparation.

### 8-03. PAINT APPLICATION.

(a) All painting shall be done in a neat, thorough, and workmanlike manner. Except where otherwise specified or specifically directed, all paint coats shall be applied by either brush or spray in such manner as to produce an even coating of uniform thickness completely coating all corners and crevices. All painting shall be done by thoroughly experienced workmen. Care shall be exercised during spraying to hold the nozzle sufficiently close to the surfaces being painted to avoid excessive evaporation of the volatile constituents and loss of material into the air. Paint shall be applied only to surfaces that are thoroughly dry and only under such combination of humidity and temperatures of the atmosphere and surfaces to be painted as will cause evaporation rather than condensation. (A practical test is to wipe a damp cloth on the surface to be painted. If the moist streak dries promptly, conditions conducive to evaporation prevail.) In no case shall any paint be applied to surfaces upon which there is frost or moisture condensation, or during rainy or misty weather, without suitable protection as approved by the contracting officer. Painting during unfavorable weather conditions shall be carried on in a heated building. While any painting is being done, the temperature of the surfaces to be painted and of the atmosphere in contact therewith shall be maintained at or above 50 degrees F. All paint when applied shall be approximately (within fifteen degrees of) the same temperature as that of the surface on which it is applied. Where protection is provided for paint surfaces, such protection shall be preserved in place until the paint film has properly dried and removal of the protection is authorized by the contracting officer. Movable parts, hardware, and other surfaces not required to be painted shall be cleaned and protected to the satisfaction of the contracting officer.

(b) Coverage. - The surface area covered per gallon of paint specified shall be not greater than 425 square feet per gallon.

## 8-04. PRIMING COATS.

(a) Unpainted Surfaces. - The surfaces of all ferrous metal work to be embedded, non-ferrous metal-coated surfaces, machined surfaces, surfaces requiring welding, and surfaces which will be in riveted contact shall not be painted. All other exposed ferrous surfaces, unless otherwise specified shall receive one priming coat of Synthetic Red Lead Primer.

(b) Structural Parts shall receive one shop priming coat.

(c) Machined Surfaces shall immediately after final inspection be thoroughly cleaned of all foreign matter and coated with a heavy film of Rust Preventive Compound, U. S. Army Specification 2-84A.

(d) Screw Threads shall be protected by a coating of heavy oil.

## 8-05. PAINTS AND PAINT FORMULAE.

(a) General. - Paints shall have the composition as indicated below or as otherwise approved by the contracting officer. All paints shall be guaranteed by the manufacturer not to gel, liver, or thicken deleteriously or form gas in a closed container within a period of one year from date of manufacture.

(b) Processing of Paints.

(1) Except where otherwise specified or authorized, all paint shall be made by grinding together dry or paste pigments and a liquid vehicle to form a smooth paint that will flow freely and will not settle or react deleteriously in containers.

(2) Grinding shall produce a fineness such that coarse particles and skins will not exceed 1.5 percent (total residue left on No. 325 mesh screen, based on pigment). The grinding shall be done in a roll or pebble mill at temperatures that will not cause polymerization.

(3) Skinning shall be negligible after exposing 6 ounces of paint in a tightly closed 8 ounce glass container to sunlight for a total time of 24 hours.

(4) The resulting paint shall have satisfactory brushing and leveling properties, shall set to touch in not less than one hour nor more than four hours, unless otherwise specified, and shall provide a satisfactory film and a smooth even surface without undue gloss, suitable for proper application and adhesion of subsequent paint coats, as approved by the contracting officer. Sufficient suitable driers shall be added to make the paint dry hard within 18 hours.

(5) In view of potential variations resulting from variable processing equipment and technique, the manufacturer may be allowed, where necessary to produce the specified viscosities, to make slight changes in formula proportions, subject to specific approval of the contracting officer.

(c) Synthetic Red Lead Primer, to be used under all grey enamel finish coats shall be composed of materials conforming, where applicable, to the specified requirements and shall be mixed in proportions as follows:

| | |
|---|---|
| Red Lead | 16.5% by weight |
| Iron Oxide | 38.2% |
| Zinc Yellow | 5.5% |
| Diatomaceous Silica | 6.0% |
| Vehicle (see par. 8-06) | 28.0% |
| Thinner | 5.8% |

The paint shall have a consistency of flow of between 25 and 40 seconds through the 0.15 inch diameter orifice of a standard consistency cup when tested in accordance with the procedure specified in paragraph 9 and 10 of A.S.T.M., Specification D 333-37 for "Methods of Testing Nitrocellulose Clear Lacquers and Lacquer Enamels." It shall have satisfactory brushing and leveling properties, shall set to light touch in not less than 2 hours nor more than 5 hours, and shall dry hard for recoating in not more than 18 hours, when tested in accordance with paragraph P-2d of Federal Specification TT-V 81a, entitled "Varnish; Mixing (for) Aluminum Paint." The vehicle shall be a synthetic resin varnish consisting of a phenol formaldehyde resin with the necessary oils and volatile thinners to produce elasticity, water-proofness, adherence, and durability in the finished paint film. It shall meet the detailed requirements of paragraph 8-06.

8-06. PHENOLIC RESIN VARNISH VEHICLE shall conform to the following requirements:

(a) Oil-resin ratio shall be 33 gallons of oil to 100 pounds of resin.

(b) Shall be clear and transparent and entirely free from resin, estergum, or other non-phenolic resins. Not less than 50 percent by weight of the vehicle shall consist of non-volatile oil and resin.

(c) The resin content shall be 100 percent para phenyl phenol-formaldehyde condensate similar and equal to Bakelite BR 254, and shall conform to the current U. S. Navy Department Specification 52R10 entitled "Resin Phenol-Formaldehyde."

(d) The volatile thinner shall contain not more than 80 percent mineral spirits and not less than 20 percent high flash coal tar naphtha or high flash hydrogenated petroleum naphtha and shall be free from toxic hydrocarbons such as benzol.

(e) The oil content shall be a ternary oil mixture composed of 40% linseed, 30% liquid oiticica, and 30% "dehydrated" castor oil.

(f) The flash point shall be not below 30 degrees C. in a closed cup tester.

(g) Shall pass a Kauri Reduction Test of 120 percent, using the method described in paragraph F-2g, Federal Specification TT-V-81, for "Varnish; Mixing (for) Aluminum Paint."

(h) Shall show no skinning after 48 hours in a 3/4 filled, tight container.

(i) Flow-out films on tin plate panels dried 72 hours shall withstand immersion in cold water for 96 hours, and in distilled water at 200 degrees F. for 7 hours without showing more than a slight haze which shall disappear within one hour, and shall show no other signs of deterioration. The panel shall be allowed to dry and cool for 15 minutes after removal from hot water and shall then be inspected for signs of failure.

8-07. PIGMENTS.

(a) Carbon Black shall conform to either Federal Specification TT-B-601, entitled "Boneblack; Dry, Paste-in-Japan, Paste-in-Oil" or Federal Specification TT-L-71 entitled "Lampblack; Dry, Paste-in-Japan, Paste-in Oil."

(b) Lead Titanate shall be similar and equal to Titanox "L" as manufactured by the Titanium Pigment Corporation.

(c) Red Lead shall conform to Federal Specification TT-R-191a (97) percent Grade for "Red Lead; Dry and Paste-in-Oil."

(d) Iron Oxide shall contain not less than 98 percent $Fe_2O_3$ and shall not contain any organic coloring matter.

(e) Diatomaceous Silica shall be an approved commercial grade.

(f) Zinc Yellow shall contain not less than 40 percent $CrO_3$. It shall be a basic zinc potassium chromate, soluble in acetic acid, free from lead compounds, and containing no added zinc oxide, and shall be stable or non reactive with the pigments and vehicles specified.

(g) Titanium Dioxide shall be similar and equal to either "Ti-Pure O" as manufactured by Krebs Pigment & Color Corporation or "Titanox NC" as manufactured by the Titanium Pigment Corporation.

## 8-08. THINNERS AND SOLVENTS.

(a) Mineral Spirits shall have the following properties:

| | |
|---|---|
| Gravity | 43-47 degrees Baume |
| Flash Point (Closed cup) | 100 degrees F. Min. |
| Initial Boiling Point | 300-310 degrees F. |
| End Point | 405 degrees F. Max. |
| A.S.T.M. Copper Strip Test | Negative |
| Solvency (Kauri-Butanol) | 41 cc at 77 degrees F. Min. |

(b) Dipentine shall have the following properties:

| | Maximum | Minimum |
|---|---|---|
| Specific Gravity at 15.5 degrees C. | 0.854 | 0.845 |
| Refractive Index at 20 degrees C. | 1.477 | 1.472 |
| Unpolymerized Residue (percent) ($38N\ H_2SO_4$) | 2.5 | |

A.S.T.M. Distillation Range:

| | |
|---|---|
| 5% Distilling at | 173 degrees C. |
| 10% Distilling at | 175 degrees C. |
| 97% Distilling at | 188 degrees C. |
| Color-Lovibond 500 Amber | 3 |

Appearance: Clear and free from suspended matter.

(c) Toluol shall conform to U. S. Navy Department Specification 52T7 entitled "Toluene (Toluol)," except that it shall have a solvency (Kauri-Butanol Method) of not less than 100 cc. at 77 degrees F.

(d) Xylol shall conform to A.S.T.M.Specification D364-36 for "Industrial Xylene (Xylol) or 'Solvent Naphtha,'" except that it shall have a solvency (Kauri-Butanol Method) of not less than 93 cc. at 77 degrees F.

(e) Normal Butyl Alcohol (Butanol) shall conform to A.S.T.M. Specification D331-35 for "Ethylene Glycol Monoethyl Ether."

## 8-09. MISCELLANEOUS MATERIALS.

(a) Oil, Linseed shall conform to Federal Specification JJJ-O-331 for "Oil; Linseed, Boiled," or JJJ-O-336, for "Oil; Linseed, Raw," as specified or required.

(b) Insulating Varnish, U. S. Navy Department Specification 52-V-13b, entitled "Varnish; Insulating, (for) Electrical Purposes."

(c) Creosote Paint for surface treatment of timber shall conform to Federal Specification TT-W-561a, entitled "Wood-Preservative: Creosote (for) Brush and Spray Treatment."

(d) Ortho-Phosphoric Acid ($H_3PO_4$), shall be commercially pure product, in liquid form, containing not less than 75 percent $H_3PO_4$.

(e) Sodium Dichromate, ($Na_2Cr_2O_7$) shall be a commercially pure product in crystalline form containing not less than 85 percent $Na_2Cr_2O_7$.

8-10. INSPECTION.

(a) Unless otherwise specifically authorized, inspection of all materials for the paints and chemical rust inhibitor and the manufacture thereof, will be made by a representative of the contracting officer. All samples of materials and of the finished processed products will be tested and analyzed for conformity with the specifications by the Government. The inspector will collect for testing, samples of each of the materials to be used in the manufacturing processes and will then seal the material containers until test results from the samples indicate that the various materials conform to specifications. He will witness the breaking of the seals on the approved material containers and the compounding of the materials for the product being manufactured, will collect samples of the finished product for testing, and will witness the placing, sealing, and labeling of the finished product in containers for shipment. After the finished products have successfully passed the prescribed test, shipment of the sealed containers will be authorized.

(b) In the case of ready-mixed and packaged paints of standard manufacture, other than those specified by trade name, the contractor shall furnish a sample in the standard stock package, together with a certified copy of the complete chemical analysis, for test and approval by the contracting officer.

8-11. PAYMENT for all paint and painting will be included in the contract price for the respective metals or items painted.

# IROQUOIS DAM

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Specifications

For

SPILLWAY GATES

## SECTION II - GENERAL FEATURES

### 2-01. GENERAL.

(a) The following shall constitute the materials and equipment that are included under "Spillway Gates:"

(1) Forty-one top gate sections and 33 bottom gate sections complete, including structural steel frames and skin plates, wheels, lubrication systems and fittings, guide pins and sockets, water seals, lifting and coupling devices, air bubblers and tools.

(2) Two lifting beams which will be connected to the lifting blocks of cranes, complete with structural frames, guide rollers, guide pins and sockets, lifting and coupling devices similar to those on the gates, and connecting links to the crane sheave blocks.

(3) The gate dogging devices which are to be installed in the concrete piers, including all castings, pins, push rods, levers, bushings, bolts, and lubrication systems and fittings, but not including the structural steel grillage, anchor bolts, pipe casings and supports for the dogs which are embedded in the concrete.

(4) The gate track rails and gate guide rails including all rail clips, splice bars, machine bolts, studs, wedges, shims, and other appurtenances, for service and emergency slots, and for the repair and storage chambers, but not including the structural steel guide frames in the repair and storage chambers.

(5) One portable, electric motor-operated grease compressor for lubricating the gate wheel bearings and dogging machinery.

(b) The contractor shall coordinate his designs and detailed drawings with those of related structures by means of drawings or information which will be furnished by the contracting officer.

(c) Holes which are to be used for connection of equipment not furnished by the contractor shall be drilled or reamed to metal template furnished by the contracting officer or made from information given by him; or drilled or reamed with the parts assembled. All templates and all casting patterns shall be and remain the property of the Government.

### 2-02. GATES AND LIFTING BEAMS.

(a) Forty-one top gate sections and 33 bottom gate sections are required. Each gate section is 24'-0" high and about 53 feet in overall length. Each bottom section and 8 top sections are equipped with lifting devices and the remaining 33 top sections are equipped with lifting and coupling devices enabling the crane operator to operate each top section separately together with a bottom section.

(b) Each top section is equipped with an air bubbler system near the bottom with 3 nozzles discharging upstream and 3 nozzles discharging downstream, with proper connection for attaching a flexible air hose at the top.

(c) Each gate section consists of a steel skin plate on upstream side riveted to a supporting steel frame work of vertical and horizontal girders and stiffeners. The bottom and side edges of each top section are equipped with water seals. No seals are provided on the bottom sections. The water load on each section is distributed by the skin plate and stiffeners to the horizontal girders, and thence to the vertical girders at the sides. Double flanged wheels on over-hung axles are mounted on the vertical girders and take the horizontal load on the gate into the gate tracks on the piers.

(d) The lifting beams consist of a structural steel frame with lifting and coupling devices similar to those in 33 of the top gate sections. The beam spans the entire opening and the ends are equipped with guide rollers. The cross heads of the lifting device are coupled to the lifting blocks of the crane.

(e) The position, with reference to the skin plate, of the center line of lifting hooks shown on the drawings is dependent upon the center of gravity of the gate sections. The final position of the lifting hooks shall be subject to the approval of the contracting officer after a weight estimate is secured. The position of the hooks shall be the same for all gate sections and counterweight shall be added if directed by the contracting officer.

2-03. GATE DOGGING DEVICES. - The dogs are of the vertical reaction type and are operated by vertical push rods through pipe shafts and connected to levers at the tops of the piers. The gates may be dogged at various elevations, the dogging steps being the treads of the gate wheels. The dog castings pivot on horizontal pins set in structural steel grillages which are embedded in the piers. Pins are lubricated by means of copper tubing running through the push rod shafts to the tops of the piers and terminating in button-head grease fittings.

2-04. TRACK AND GUIDE RAILS. - The gate tracks are vertical crane rails attached to the embedded steel towers on the downstream side of each slot. The guide rails are light rails set vertically at the upstream side of each slot. Both track rails and guide rails are adjustable laterally and in the up-and -downstream direction. Guide rails are provided, also, on both upstream and downstream sides of the guides in the gate repair and gate storage chambers.

## SECTION III - DESIGN LOADS AND STRESSES

### 3-01. GATES AND GATE TRACKS.

(a) Gates. - All parts of the gates shall be designed to withstand either of the following loading conditions in addition to stresses due to lifting, lowering, or resting on the sill:

(1) A horizontal water load corresponding to a water surface on the upstream side at Elev. 248, (top of gates) and tailwater at Elev. 229 with the gate resting on the sill.

(2) A horizontal ice load of 10,000 lbs. per lineal foot of gate length between pier faces, distributed over 4 feet vertically, and with its center of pressure at any level on the vertical projection of the gate; and, in addition, a water load corresponding to a surface 6" below the ice surface. No tailwater shall be considered for this condition. The weight of the water shall be taken as 62.5 lbs. per cubic foot.

For Condition 1, the unit stresses in structural carbon steel shall not exceed those corresponding to an 18,000 lb. per square inch base as specified in the American Institute of Steel Construction's "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings" as revised January 1934, except that the thickness of all members shall be increased 1/16" above the resulting designed thickness to allow for corrosion. The unit stresses in structural silicon steel shall not exceed those corresponding to a 24,000 lb. per square inch base, and the resulting designed thickness shall be increased 1/16" to allow for corrosion. The unit stresses for other materials shall not exceed those normally used, in good practice, for the materials involved. The radial wheel loads shall not exceed 180,000 lbs.

For Condition 2, the unit stresses in any material shall not exceed 150% of those allowed for Condition 1, except that no allowance shall be made for corrosion. The radial wheel loads shall not exceed 225,000 lbs.

(b) Gate Tracks. - The tracks and track fastenings shall be designed to sustain simultaneously the maximum radial wheel load plus the maximum assumed side thrust of 37½% of the radial load and to transmit these loads to the concrete of the pier without overstressing the steel or the supporting concrete.

### 3-02. LIFTING AND COUPLING DEVICES.

(a) All parts of the lifting and coupling devices, including those in the lifting beams and the structural parts affected in the gates shall be designed for a vertical load (per gate) of 675,000 lbs. The unit stresses shall not exceed those normally used, in good practice, for the materials involved. Each wedge, and all parts of the wedge-operating machinery, shall be designed for a thrust of 3,000 pounds in the screw shaft. Each wedge shall be designed to support a vertical load from the coupling tie bars of 140,000 pounds.

(b) All guide pins and sockets for centering gate sections and lifting beams shall be capable of transmitting, at normal working stresses, reactions due to wind pressure on the full depth gate section while it is suspended from the crane. Wind pressure shall be assumed at 40 lb. per sq. ft. maximum and the gate section area as 1275 sq. ft.

3-03. GATE DOGS.- Each pair of dogs and dog pins shall be designed to support a load of at least 150 % of the weight of the top and bottom sections linked together, but for not less than 175,000 lbs. The unit stresses shall not exceed those normally used, in good practice, for the materials involved.

## SECTION IV - STRUCTURAL DETAILS.

### 4-01. GATES (RIVETED DESIGN)

(a) The general construction of the gates shall be substantially as shown on the Government's drawings. Riveted construction shall be used, in general, but welding will be permitted for calking joints and plugging holes. If approved by the contracting officer other minor details may be welded. In all cases, welding and riveting shall conform to the provisions of Section VIII. All parts of the gates shall be adequate to transfer the loads specified from their points of application to the track rails without exceeding the unit stresses specified and without excessive deformation. Except as provided below, the gate structure shall be of structural carbon steel.

(b) Structural silicon steel shall be used where called for on the drawings or in these specifications and, except for the skin plate may be used for other structural parts, provided no horizontal girder deflection under maximum design load for any of the prescribed conditions of loading shall exceed 7/8".

(c) In designing the horizontal girders a width of the skin plate equal to the distance between the outer rivet gauge lines in the outstanding angle legs plus 24 times the skin plate thickness, may be figured as cover plate area. Proper allowances shall be made for unsymmetrical sections and for combined stresses.

(d) All connections and details shall be of sufficient strength to develop the full strength of the parts connected, and each connection shall have at least two rivets. The minimum rivet size shall be 7/8". Details shall be such as to give free access for inspection and painting, and all water pockets shall be drained.

(e) All gate sections shall be built in two pieces each with provisions for horizontal field splicing. The design of the splices shall be such as to require as little field work as possible, consistent with strength and watertightness requirements.

(f) Provision shall be made so that a man may readily reach and operate by hand or service the wedge operating mechanisms and the devices for emergency hand operation of the coupling links. The top sections shall have a ladder near each end on the side opposite the skin plate for access to the wedge operating machinery and the coupling device cross-heads.

(g) The design for condition 2 shall take into account the transfer of load from any horizontal girder to the adjacent girders through the vertical diaphragms.

(h) Care shall be taken in the design that proper clearances are maintained between the gate and the dam structures at all points.

(i) Each gate section shall be equipped with connections for latching to the lower sill on the downstream side of the crane when the section is being transported by the crane. The connections shall be designed to withstand their proportion of the horizontal wind load specified in Paragraph 3-02. (b).

4-02. GATES (ALTERNATE WELDED DESIGN). - The contractor may, at his option, submit designs for all welded gates as an alternate to the riveted design shown on the Government's drawings and described in paragraph 4-01.

If the design and details are satisfactory to the contracting officer the welded design will be approved for construction.

### 4-03. TRACK AND GUIDE RAILS.

(a) The gate track rails shall be 175 lb., heat-treated Lorain crane rails, Section No. 175-418, and will be attached to the embedded steel powers on the downstream side of each slot by means of the corrosion-resisting steel studs and the rail clips. Closely spaced steel wedges shall be provided for adjustment in the up-and-down stream direction of 1/4" either way. Lateral adjustment of 5/16" in either direction shall be provided for by means of corrosion-resisting steel studs through rail webs.

(b) The guide rails in the spillway slots shall be 49.7 pound A.S.C.E. rails, Section 5040, and will be attached to the upstream side of the slots by means of bolts through oversize holes in bars welded to the rail bases. 3/8" normal shims in 1/16" increments shall be provided between the bars and the tower members and the holes in the bars shall be large enough to allow a lateral adjustment of 1/4" either way.

(c) The guide rails in the gate repair and storage chambers shall be 49.7 pound A.S.C.E. rails, Section 5040, and shall be furnished with fittings and anchors for attachment to the guide.

## SECTION V - MECHANICAL DETAILS

### 5-01. LIFTING AND COUPLINGS DEVICES.

(a) The lifting and coupling device for each top section shall be essentially as shown on the drawings and shall consist of swinging links suspended on horizontal pins from crossheads connected by tie bars to double hooks at the top of the gate section. The hook links engage similar hooks in the bottom gate section. Each pair of hook links is geared together to operate in unison and the two pairs in each gate section are mechanically interlocked to provide simultaneous operation. A latch to hold the links open and a latch tripper to allow them to close are provided in each cross-head and are operated by the vertical movement of the cross-head. The lifting beam is provided with similar cross-heads and links. Emergency hand operation is provided for the links in both the lifting beam and the gate sections. Electric-motor operated wedges near the top of the gate serve to hold the sections together for operation as a unit.

(b) The device is intended to perform the following functions by means of the crane with one crane operator (one additional man is required when connecting or disconnecting the gate sections):

(1) Connect the lifting beam to or disconnect it from the top of any gate and raise or lower the gate as desired.

(2) Connect the lifting beam to, or disconnect it from, any top gate section - or any bottom gate section when no water is flowing over it - and raise or lower the gate section as desired.

(3) Connect any upper gate section to, or disconnect it from, any lower gate section.

(c) The functions are performed as follows:

(1) (2) The lifting beam is lowered until it rests on top of the gate or gate section and the crane operator continues to lower the lifting beam cross-heads until the links engage the lifting hooks. The crane operator may then reverse the hoist motor and raise the gate after the small upward movement of the cross-head is taken up.

(3) To disconnect the gate sections the lifting beam is lowered until the top hooks are engaged as in (1) and (2). The hoist motor is then reversed and the lifting beam cross-heads and links are raised a short distance, elongating the coupling bars slightly so that the wedges near the top of the gate may be withdrawn by starting the wedge-operating motors. After the wedges are removed the lifting beam cross-heads are again lowered, together with the cross-heads in the gate, until the links in the gate cross-heads spread enough to allow the latches to drop and hold them open, disconnecting the sections. The top section may then be removed by hoisting until the gate cross-heads come in contact with the upper stops. Before the cross-heads reach the upper stops the latches are tripped by adjustable set screws allowing the links to drop into position to engage the hook when it is desired to connect the sections again. To connect the gate sections the top section is lowered until it rests on the top of the bottom section. The lifting beam is lowered further and the links in the gate cross-heads are spread by contact with the sloping tops of the hooks until they drop into position. The hoist motor is then reversed and the whole assembly tightened so that the wedges may be driven and the lifting beam removed.

(d) Strength, simplicity and ease of operation shall be considered of prime importance in the design.

(e) Hooks, connecting castings, wedges and lifting links shall be alloy steel castings. Lifting links shall be equipped with self-lubricating bushings pressed in the link castings and doweled. Connecting bars shall be of structural silicon steel. The cross-heads shall be of structural silicon steel plates, or reinforced rolled sections, properly connected, braced, and finished to bear on the seats in the gate and lifting beam.

(f) Pins through hooks, connecting castings, and lifting links shall be of forged alloy steel and pin nuts shall be of pressed steel with recess and finished face, Lifting link latches and all levers and yokes in the mechanical interlock shall be carbon steel castings. Connecting links in the interlock shall be of structural carbon steel and pins of rolled nickel steel. All bearings for rotating or oscillating shafts and all bearing surfaces rotating or oscillating on fixed pins shall be fitted with self-lubricating bushings. Push rods shall be of standard weight black steel pipe rods welded in at the ends and threaded right and left hand for adjustment. Yokes shall be threaded right and left hand to match. Rods shall be of bolt steel and shall be fitted with bronze jam nuts. The lever for hand operation of the links shall be a carbon steel forging or casting.

(g) The speed reduction units connecting the threaded wedge operating rods to the drive motors shall be inclosed in felt-sealed, oil-tight, cast steel or welded steel cases properly braced and connected to take the thrust of the wedge into the gate structure. The cases shall be provided with oil level plugs and drain plugs and the gear covers shall be easily removable for inspection of the gears. The gears shall run in a suitable lubricant, and lubrication shall also be provided for the threads of the operating rod. Lubrication shall be effective at temperatures down to-40° F. The wedge operating rods shall be of rolled nickel steel. Gears shall be of nickel steel, carburized. Bearings shall be of phosphor bronze. A flexible coupling shall be provided at the end of the high speed shaft for connection to the motor shaft. A weather-tight, copper-bearing sheet steel removable cover 1/8" thick shall be provided to inclose the entire mechanism except the wedge and operating shaft.

## 5-02. GUIDES.

(a) The lifting beams shall be provided with four double flanged rollers at each end which shall fit between the track and guide rails in the spillway gate slots and hold the beam, as it is lowered, in the proper position to engage the guide sockets on top of the gate. Clearance between rail heads shall be the same as the clearance of the gate wheels. Rollers shall be equipped with pressed in self-lubricating bushings flanged to take end thrust, and provision shall be made for 7/16" slip of the roller on the axle in each direction. Vertical tapered guide pins, one near each end on the bottom of the beam, shall engage sockets in the gate with sufficiently close clearance so the lifting links will engage the hooks freely. Two sockets on the top of the beam shall engage guide pins on the crane trolley when the lift beam is in its highest position. Similar guide pins and sockets shall be provided to guide the top section of the gates to its proper position on top of the bottom section. The details at the end of the beam shall be such that the beam may be dogged in any gate slot.

(b) No guides are necessary for the gates themselves, the double-flanged wheels serving that purpose.

(c) The end guide rollers on the lifting beam shall be alloy steel castings. The guide pins on the lifting beams and top gate sections shall be alloy steel forgings provided with hexagon nuts of tobin bronze. The guide sockets shall be carbon steel castings and shall be bolted under-neath the top girder web on each gate section with tobin bronze bolts. The bottoms shall be open to prevent filling with ice or debris.

5-03. WHEEL ASSEMBLIES.

(a) General. - All parts of the wheel assembly shall be designed for a direct radial load of 180,000 lbs. and a simultaneous axial load of 70,000 lbs. in either direction, both loads being applied at the wheel tread and while the wheel is either stationary or revolving at one-half revolution per minute.

The roller bearings shall be so proportioned as to sustain these combined loads with a factor of safety of not less than three based on the ultimate strength of the material. They shall also be capable of sustaining, under test, a radial load of 300,000 lbs. combined with a thrust load of 100,000 lbs. applied at a point on the tread of the wheel, while revolving at a speed of one-half revolution per minute, without appreciable permanent deformation.

The axles shall be turned with a 1/8" eccentric for aligning the wheels after the wheel assemblies are installed in the gate. Provision shall be made in the design for a slip of the wheel of 7/16" in either direction from the normal position to allow for variation in length of gate due to temperature changes and for tolerance in the track rail setting.

(b) Wheels. - The gate wheels shall be double flanged, heat-treated, rolled carbon steel.

(c) Axles. - Axles shall be alloy steel forgings, heat-treated to produce the following minimum physical results;

| | |
|---|---|
| Tensile strength | 100,000 lbs. per sq. in. |
| Elastic limit | 75,000 lbs. per sq. in. |
| Elongation in 2" | 19% |
| Reduction in area | 50% |

(d) Roller bearings. - The design of the roller bearings and their mounting in the wheels and on the axles shall be such that they may be readily removed and disassembled for inspection and cleaning. The races and rollers shall be of roller bearing alloy steel, heat-treated, and with bearing surfaces uniformly hardened to proper depth to insure sufficient strength to resist the maximum pressures between the bearing surfaces of rollers and races. Retainers shall be designed and constructed to properly space and guide the rollers with a minimum of friction.

(e) Hub Covers and Bearing Seal Covers. - Hub covers and bearing seal covers shall be of rolled steel, forged steel, or carbon steel castings, and shall be designed to resist the thrust load on the wheel. Inside surfaces shall be sand-blasted or machined to remove all scale and sand or other foreign material.

(f) Bearing Seals. - Bearing seals shall be designed to prevent the entrance to the bearings of grit or of water under a static pressure of 25 pounds per square inch or less. Sealing material shall be made of flexible packing having a low coefficient of friction. The physical characteristics of this material shall not be substantially affected by long exposure to air, water, mineral oil or extremes in temperature of the air which are likely to be encountered at the site of the dam. A spring device shall be incorporated in the seal to produce a uniform pressure of the sealing element around the shaft. The entire assemble shall have sufficient strength and rigidity to prevent leakage between the seal and the bearing seal cover in which the seal shall have a force fit. If external cages are used in the seal assembly, they shall be of non-corrodible metal or heavily cadmiumplated steel. If internal stiffeners are molded in the packing material, they may be of pressed steel or other approved metal. Springs shall be of bronze. "Klozure" seals as manufactured by the Garlock Packing Company, seals using "Neoprene" packing materials with an internal stiffener ring as manufactured by the Michigan Leather Packing Company, or approved equal, will be acceptable.

(g) Bolts and Nuts. - Bolts and nuts for the hub covers and bearing seal covers shall be made from "high-strength steel." A spring steel lock washer shall be provided under each nut.

(h) Gaskets. - All gaskets shall be cut from compressed, asbestos-fibre sheet packing 1/32" thick. They shall be accurately cut to size with bolt holes 1/16" larger in diameter than the bolts.

(i) Lubrication Equipment and Lubrication. - The wheels on each side of each gate section shall be equipped with a centralized lubrication system, Farval or equal, with strainers and measuring valves. The grease supply to the bearings shall be taken from the supply lines through flexible tubing to the axles and thence through the axle to the bearings. Supply pipes shall be extra strong black wrought steel butt-weld pipe, pickled to remove all scale from the interior. Tubing shall be of copper with nominal wall thickness of 1/16" and with flared joint fittings of Marine and Refrigeration type. All pipe, tubing, and fittings shall be assembled with tight joints and shall be suitable for a cold oil working pressure of 2,000 lbs per sq. in. Fittings for connection to the compressor shall be of the button-head type. The fittings shall be easily accessible from the downstream side of the gate section and as close as practicable to the top of the section.

During or after assembly, the supply pipes, tubes and fittings, as well as the space surrounding the bearings and journals shall be completely filled with a lubricant recommended by the wheel bearing manufacturer, or approved equal. Any lubricant selected shall be effective at - 40°F.

## 5-04. WATER SEALS.

(a) Side Seals. - The seals at the sides of each top gate section shall be 3" standard steel pipe. Proper allowance shall be made in the design for all tolerances and clearances in the gates and guides.

(b) Bottom Seals. - No bottom seals are required at the sill, but a continuous steel bar shall be provided on the bottom of each top gate section which shall serve as a bearing surface while the gate sections are in contact.

5-05. GATE DOGGING DEVICES. - The dogs shall be alloy steel castings and shall have phosphor bronze bushings pressed in and doweled. Pins shall be alloy steel forgings and shall be drilled, tapped and grooved for grease pipe connections and for distribution of grease to the bushings. Push rods shall be black steel pipe with welded in rods at the ends for connection to yokes at the dogs and operating levers. Yokes shall be carbon steel castings and yoke pins of tobin bronze. Operating levers shall be steel forgings mounted, on cold rolled steel pins set inself-lubricating bushings. Grease pipes shall be 3/8" O.D. annealed copper tubing with flared joint Marine and Refrigeration type fittings and shall be suitable for a cold oil working pressure of 2000 lb. per square inch. They shall be equipped with button-head type grease fittings of the same size as those on the gates and which shall be easily accessible from the top of the piers.

5-06. AIR BUBBLERS. - Air bubblers shall be 3/4 inch brass pipe with stainless steel nozzles. Nozzle openings shall be 1/8" in diameter. The air supply pipe shall run to the top of the gate section at one end and shall be equipped with a connection for a flexible air hose which will run to the main air line on the spillway deck.

5-07. GREASE COMPRESSOR. - The grease compressor shall be mounted on a suitable 2, 3, or 4 wheel pneumatic tired chassis and the entire unit shall be easily transported along the deck by one man. Tires shall be standard commercial size. The compressor unit shall consist of a single-phase electric motor for operation on 110-120 volts, an air compressor driven by the motor and a grease reservoir of not less than 100 pounds capacity. A flexible grease line terminating in a valve and fitting for connection to the gate wheel lubrication systems, and long enough to reach from the upstream side of the roadway to the grease inlet on either gate section when the gate is dogged, shall lead from the grease reservior. All parts of the system shall be suitable for handling the lubricant specified for the gate wheel lubrication systems. There shall be furnished, also, an air-operated grease gun for servicing the dogging assemblies which shall have a grease capacity of not less than 5 pounds and which shall be equipped with an air hose with connection to the air compressor and necessary valves and fittings for connection to the grease inlets. The air hose shall be long enough to permit servicing the gate dogging assembilies in the upstream slots. The grease gun shall be suitable for handling the high pressure lubricant specified for bearings other than gate wheel bearings. A full complement of wrenches and any other small tools necessary for normal maintenance of the grease compressor shall be furnished with it. All parts of both grease systems shall be suitable for a cold oil working pressure of 2,000 lbs. per sq. in. A heavy duty rubber-covered flexible cable 50 feet long with necessary fittings shall be provided for plugging in the motor at the electrical outlets on the dam. Suitable facilities shall be provided on the chassis for neatly stowing the grease hose, air hose and gun, tools and the power cable.

## SECTION VI - WEDGE-OPERATING EQUIPMENT - ELECTRICAL

6-01. MOTORS. - Motors shall conform to the standards of the American Institute of Electrical Engineers and of the National Electric Manufacturers Association. They shall be six pole, 1/6 H.P., continuous rating, 440 volt, three phase, 60 cycle, squirrel cage induction motors, ratings according to the Standardization Rules of the A.I.E.E. They shall be totally enclosed and mounted approximately as shown on the drawings.

6-02. LIMIT SWITCHES. - Adjustable limit switches shall be provided for both directions of travel, but other control equipment and wiring will be furnished by the Government. Spring stops for both directions of travel shall be provided such that the torque at the flexible coupling shown on the drawings will not be more than 400% of the rated torque of the motor when the motor is brought to a stop.

## SECTION VII-MATERIALS

### 7-01. GENERAL.

(a) Materials. -All materials shall be of new unused stock, free from defects. Substitution of size of sections and materials from that shown on the drawings or required in the specifications shall not be made except on written approval of the contracting officer and provided that the cost to the Government shall not be increased thereby.

Materials indicated on the drawings or required in the work and not covered elsewhere in these specifications by detailed requirements, shall conform to the requirements of this section.

Any materials required which are not covered by detailed specifications herein or elsewhere in the specifications shall conform to the applicable Federal Specifications, grade and/or class as required or, in case where there are no applicable Federal Specifications, to applicable specifications of the American Society for Testing Materials (A.S.T.M.). In all other cases not specifically covered in these specifications the contractor shall furnish the highest grade commercial material or product.

(b) Inspection, Acceptance and Rejection of Materials. -All materials shall be subject at all times to inspection by the contracting officer who will select such samples in such quantities as he may deem necessary and subject the same to such tests as may be necessary to determine their qualities as herein specified, and he will accept or reject materials in accordance with the results of such tests. Tests may be repeated upon arrival of the various shipments at the site of the work as may be necessary to insure the acceptance of only such materials as will comply with the provisions of the plans and specifications.

(c) Test Specimens. -Special test specimens shall be furnished by the contractor on request; and shall be of such shape and number as designated; and shall in general conform to Federal Specifications or the specifications of the American Society for Testing Materials as to shape, size, and method of testing.

(d) Mill Test Reports. -Mill test reports certified to by qualified technicians shall be furnished when required for all material entering into this work and will, in general, be the basis of acceptance or rejection of the materials. The contracting officer may, however, require of the contractor special chemical or physical tests on any part of the material if in his opinion the conditions justify such a check.

(e) Federal Specifications. -Copies of Federal Specifications referred to herein may be procured from the Superintendent of Documents, Government Printing Office, Washington, D.C., at a price of five or ten cents each. When the term: "Federal Specifications" or "A.S.T.M.Specifications" is cited, the reference shall be construed to mean the specifications as modified by any amendments promulgated before the date of opening bids for the contract.

7-02. STRUCTURAL CARBON STEEL. -Structural carbon steel shall conform to Federal Specification QQ-S-711a for "Steel, Structural; (for) Bridges," Class A. Surface imperfections shall be remedied by arc-welding and according to Government practice. The chemical properties of the steel shall be such as to permit it to be readily welded by this process.

7-03. RIVET STEEL. - Rivet steel shall conform to Federal Specification QQ-S-711a for "Steel, Structural; (for) Bridges," Class C.

7-04. STRUCTURAL SILICON STEEL. - Structural silicon steel shall conform to the Standard Specifications of the American Society for Testing Materials for "Structural Silicon Steel," Designation A 94-39.

7-05. COPPER-BEARING STEEL. - Copper-bearing steel sheets and plates shall conform to Federal Specification QQ-S-711a for "Steel, Structural; (for) bridges," Class B.

7-06. ALLOY STEEL CASTINGS. - Alloy steel castings shall conform to the Standard Specification of the A.S.T.M. for "Alloy Steel Castings for Structural Purposes," Designation A 148-36, Class B., Grade 2.

7-07. CARBON STEEL CASTINGS. - Carbon steel castings shall conform to Federal Specification QQ-S-681a, for "Steel; Castings," Class 2, except where shown otherwise on the drawings or called for in these specification.

7-08. ALLOY-STEEL FORGINGS. - Alloy-steel forgings shall conform to the Tentative Specifications of the A.S.T.M. for "Alloy-Steel Forgings for General Industrial Use," Designation A 237-40T, Class E.

7-09. CARBON-STEEL FORGINGS. - Carbon-steel forgings shall conform to the Tentative Specification of the A.S.T.M. for "Carbon-Steel Forgings for General Industrial Use," Designation A 235-40T.

7-10. BOLTS AND NUTS

(a) Unless otherwise specified or called for on the drawings, the material for bolts and nuts shall conform to the Standard Specification of the A.S.T.M. for "Commercial Quality Hot Rolled Bar Steels," Designation A 107-40, Grades 22, 23, 24, or 25.

(b) The material for bronze bolts and nuts shall conform to Federal Specification QQ-B-636 for "Brass, Naval; Bars, Plates, Rods, Shapes, Sheets, and Strips," Type I, half hard.

(c) The material for bolts and nuts of "high strength steel" shall conform to the Tentative Specification of the A.S.T.M. for "Alloy-Steel Forgings for General Industrial Use," Designation A 237-40T, Class D.

7-11. ROLLED-STEEL WHEELS

(a) The steel for the gate wheels shall conform to the standard Specifications of the A.S.T.M. for "Multiple-Wear Wrought Steel Wheels," Serial Designation A 57-39. The treads of the wheels shall be heat-treated to produce a Brinell hardness of 335 to 375. The plate and hub of the wheels may show no appreciable hardness over the untreated condition, but the heat-treating process shall be such as to avoid the setting-up of internal stresses in the plate of the wheel. The contractor shall furnish the contracting officer with certified copies of charts showing the process for each heat-treatment of wheel material.

(b) The contractor may submit an alternate proposal for wheel material which may be approved by the contracting officer, provided the physical characteristics are comparable to those of the material specified above.

7-12. ROLLER BEARING STEEL. - Steel for both rollers and races of the roller bearings shall conform to the Specifications of the Society of Automotive Engineers, S.A.E. number 52100, or approved equal.

7-13. GATE TRACK RAILS.

(a) These 175 pound rails shall be new and shall conform to the Standard Specification of the A.S.T.M. for "Open-Hearth Steel Girder Rails of Plain, Grooved, and Guard Types," Designation A 2-27 for Class A, No. 1 rails with the following changes to sections thereof:

(1) Section 12(a). - The lengths of all rails shall be in accordance with the design drawings.

(2) Sections 12(b), 12(c), and 20(b). - These sections shall be ineffective.

(3) Section 16(a).- The diameter of all bolt holes shall not vary more than 1/32 inch over or under that specified.

(4) Section 16(b). - The location of all bolt holes shall not vary more than 1/32 inch either longitudinally or vertically from that specified.

(b) The track rails shall be heated uniformly throughout their entire length and cross-section to above the critical temperature, quenched, and tempered to produce a Brinell hardness of 320 to 350. Heating, quenching, and tempering shall be done with equipment which will accomodate the entire length of each piece. After heat-treatment, all rails shall be smooth on the head, straight in line and surface, and without any twists, waves, or kinks.

7-14. GUIDE RAILS. - These 49.7 lbs. rails shall be new and shall conform to the Standard Specification of the American Society for Testing Materials for "Open-Hearth Carbon-Steel Rails," Designation A1-39, with the following changes to sections thereof:

(a) Section 17(a). - The lengths of all rails shall be in accordance with the design drawings.

(b) Section 17(b). - This section shall be ineffective.

(c) Section 20(a). - The last sentence of this section shall read: "All rails shall be milled square at the ends, a variation of not more than 1/32" being permitted, and burrs shall be entirely removed."

7-15. SPLICE BARS. - All splice bars shall be new and shall conform to the Standard Specification of the American Society for Testing Materials for "Low-Carbon-Steel Joint Bars," Designation A 3-33, and shall be notched where necessary to clear rail clips.

7-16. RAIL CLIPS. - Rail slips shall be either structural steel, forged steel or cast steel, in accordance with the standard practice of the contractor, and shall be specially and accurately formed to permit the adjustment required in setting the rail.

7-17. COLD ROLLED STEEL. - Cold rolled steel shall conform to the Standard Specification of the A.S.T.M. for "Commercial Cold-Finished Bar Steels and Cold-Finished Shafting," Designation A 108-36, Grades 1 to 10.

7-18. ROLLED NICKEL STEEL. - Rolled nickel steel, unless otherwise specified, shall conform to the Standard Specification of the A.S.T.M. for "Carbon-

Steel and Alloy-Steel Blooms, Billets, and Stubs for Forgings," Designation A 17-29, Type B, Alloy Steel, Grade 13, Class I, with chemical composition controlled as follow:

| | |
|---|---|
| Carbon | 0.25-0.35% |
| Nickel | 3.25-3.75% |
| Manganese | 0.50-0.80% |

The steel shall be heat-treated to produce the most desirable physical properties. The yield point shall be not less than 65,000 lbs. per sq. in.

7-19. CORROSION-RESISTING STEEL. - Corrosion-resisting steel shall conform to Federal Specification QQ-S-763 for "Steel, Corrosion-Resisting; bars and Forgings," Grade 6 with sulphur content of 0.18-0.35 percent with phosphorus .04 (max; and shall be free machining and suitable for threading and upsetting.

7-20. TOBIN BRONZE. - Tobin bronze shall conform to Federal Specification QQ-B-636 for "Brass, Naval; Bars, Plates, Rods, Shapes, Sheets, and Strips," Type I, half hard.

7-21. PHOSPHOR BRONZE. - Phosphor bronze for bushings, unless otherwise specified, shall conform to Federal Specification QQ-B-691 for "Bronze; Castings," and shall be "Composition 10."

7-22. SELF-LUBRICATING BUSHINGS. - Self-lubricating bushings shall be of the bronze and insert type, Lubrite or equal.

7-23. BUTTON-HEAD GREASE FITTINGS. - Button-head grease fittings shall be of the giant industrial type, with 3/8" pipe threads, Alemite or equal.

## SECTION VIII - WORKMANSHIP

### 8-01. STRAIGHTENING, BENDING, SHEARING AND CUTTING.

(a) Structural materials shall be straightened in the shop by methods that will not injure the metal, before being laid out or worked on in any way. Sharp kinks or bends shall be cause for rejection.

(b) Curved members shall be accurately pressed or rolled to the required curvature and attendant deformation of the section shall be prevented or corrcted. Heating shall not be employed except with specific approval, and special precaution shall be taken to avoid overheating.

(c) Shearing, clipping, and cutting shall be done accurately and neatly and all exposed edges shall be smooth. Re-entrant cuts and copes shall be filleted before cutting. Sheared edges of plates more than 5/8" thick shall be planed to a depth of 1/4 inch. Where explicitly shown on approved shop drawings, structural shapes and plates may be cut by oxyacetylene flame directed by machine. No material shall be cut by the electric arc.

### 8-02. RIVET AND BOLT HOLES.

(a) Rivet holes in horizontal and end girders, in inner axle supports, and in vertical diaphragms at lifting device connections shall be punched or drilled at least 3/16" smaller than the nominal diameter of the rivet and reamed in assembly to a diameter 1/16" larger than the nominal diameter of the rivet, or shall be drilled full size in assembly. Holes in the skin plate, stiffeners, vertical diaphragms except as noted above, and minor parts may be punched or drilled full size. If the thickness of the material is not greater than the diameter of the holes plus 1/16", the holes may be punched. In thicker material the holes shall be drilled. Finished holes shall be 1/16" larger than the nominal diameter of the rivets to be used in them . All holes shall be accurately spaced, cylindrical, and perpendicular to the member. All countersinking shall be true and square with the hole. In punching, the diameter of the die shall be not more than 3/32" larger than the diameter of the punch. All holes shall be clean cut without torn or ragged edges. All reaming and final drilling shall be done with the component parts of the member assembled and firmly clamped together. Drilling shall be done with twist drills. Reaming shall be done with short taper reamers.

(b) If holes are punched or drilled full size, the accuracy of spacing and alignment shall be such that when parts are assembled for riveting a cylindrical pin 1/16" smaller than the diameter of the hole shall pass through, perpendicular to the plane of the connection and without drifting, not less than 75% of any group of continguous holes; and a cylindrical pin 1/8" smaller than the diameter of the hole shall pass through, perpendicular to the plane of the connection, 100% on any group of contiguous holes. Holes which require enlarging in order to pass the rivets shall be reamed.

(c) The accuracy of workmanship of holes reamed or drilled after assembly shall be such that at least 75% of any group of contiguous holes in the same plane shall show no offset greater than 1/32" between adjacent thickness of metal, except that holes for turned bolts shall be truly cylinaxial throughout and within the limits and tolerances of the American Standards Association for Metal Fits, Class 4, Snug Fit. Wherever practicable, both drilling and finish reaming for turned bolts shall be done with the component parts assembled and firmly clamped into position. If the foregoing procedure is impracticable, drilling of the separate parts shall be to template and the reaming done in assembly. After final punching, reaming or drilling, each hole shall be gone over with a satisfactory tool removing all burrs and sharp edges.

8-03. BOLTS AND NUTS.

(a) Except as otherwise specified or shown, all bolts, nuts and studs shall conform to the American Standards Association requirements for semi-finished washer-faced, regular hexagon heads and heavy hexagon nuts, and shall have cut threads, coarse thread series, Class 3 fit.

(b) Turned bolts shall meet all requirements of the foregoing general specifications for bolts and nuts. In addition, the shanks shall be turned 1/16" larger in diameter than the nominal diameter of the thread, shall be truly cylindrical and within the limits and tolerance of the American Standard for Tolerances, Allowances and Gages for Metal Fits, Snug Fit, Class 4. The un-threaded portion of the bolt shank shall be 1/16" to 1/8" longer than the thickness of the connected members. Each bolt shall be provided with a steel washer 1/4" thick.

(c) Bolts for connection of machine parts, or other parts which are to be removable, including seals, shall have nuts of tobin bronze.

8-04. RIVETS AND RIVETING. - Rivets shall have a nominal diameter of at least 7/8" except as authorized by the contracting officer. The nominal diameter shall be the actual size of the cold rivets before heating. All connections shall be accurately and securely fitted up before the rivets are driven. Drifting done during assembling shall be only such as to bring the parts into position and not sufficient to enlarge the holes or distort the metal. Rivets shall be driven by direct-acting riveters where practicable and riveters shall retain the pressure after the up-setting is completed. Where necessary to drive rivets with a pneumatic hammer, a pneumatic bucker shall be used for holding up where practicable. Rivets shall be heated uniformly to a light cherry-red color and driven while hot. They shall not be burned or over-heated. When heated and ready for driving they shall be free from slag, scale, and other adhering matter. When driven they shall completely fill the holes. Heads shall be of an approved shape, of full and equal sizes, free from fins, concentric with the shanks, shall have full contact with the surface of the member, and shall grip the assembled parts firmly together. Unless otherwise specified or authorized, counter-sunk rivets shall be chipped or ground flush. Loose, burned, badly formed, or otherwise defective rivets shall be replaced. In removing defective rivets care shall be taken not to injure the adjacent metal and, if necessary, they shall be drilled out. Calking or recupping of defective rivets will not be permitted. In any case when a cold rivet of the size specified cannot be entered with light tapping, the hole shall be reamed with a twist reamer.

8-05. WELDING.

(a) Welding will be permitted only where specifically called for on the drawings or authorized by the contracting officer. All welding shall be done by the electric arc method using a process which will exclude the atmosphere from the molten metal. The following requirements as to welding procedure apply specifically to hand welding. Machine welding processes and procedures will be permitted as specifically authorized by the contracting officer. All welding except as otherwise specified shall be done in accordance with the applicable current Codes, Specifications, and Recommended Practices of the American Welding Society.

(b) Parts to be welded shall be rigidly held by sufficient clamps or other adequate means to keep the parts in close contact and in accurate position. Adequate precautions shall be taken to minimize locked-up stresses and distortion due to heat. Each pass of all welds shall be thoroughly peened while hot with a pneumatic tool for the purpose of relieving localized welding stresses.

(c) Fillet welds in sizes up to 1/4" shall be made in on pass, and larger welds shall be made in two or more passes. Successive beads or layers shall be uniform in thickness. Each layer of weld metal shall be thoroughly cleaned before subsequent layers are deposited. Upon completion, each weld shall be thoroughly cleaned and brushed with wire brushes, and extraneous nodules of weld metal shall be removed by chipping.

(d) Wherever there is danger of the assembled structure or member becoming warped or distorted by localized welding stresses, the welds shall be thoroughly peened with a pneumatice tool to relieve such stresses. Peening for this purpose shall be done wherever directed by the contracting officer.

(e) All welds shall be free from unsound metal, cracks, overlap, and feather edges. Minor imperfections in welds may be chipped out and the defect rewelded, subject to approval. Distortions due to welding or stress-relieving shall be corrected by pressing and not by blows.

(f) Welding shall be done only by welders properly qualified in the work of the actual process employed. The contractor shall assign to each welder an identifying number, letter or symbol which shall be stamped in the metal adjacent to and at intervals of not more than three feet along all welds which he makes. Before beginning the production of welded work, the contractor shall furnish to the contracting officer satisfactory evidence, in the form of a certificate by a recognized testing agency or by actual demonstration, that each welder to be employed on the work of this contract has within one year of the date of this contract satisfactorily performed the qualification tests prescribed by the American Welding Society in its "Code for Fusion Welding and Gas Cutting in Building Construction" (Latest Edition), using the detailed procedure to be followed in actual production under this contract. Expense of any tests necessarily performed under this provision shall be borne by the contractor. The contractor shall require any welder to repeat these tests when in the opinion of the contracting officer the work indicates a reasonable doubt of the welder's efficiency.

## 8-06. GIRDER END CONNECTIONS AND STIFFENERS.

(a) The end connection angles of all horizontal girders shall be fitted to a bearing against the flanges of the girders. The faces of the outstanding legs of the connection angles shall be milled to a true bearing against the webs of the vertical end girders and sufficient extra thickness of connection angles shall be allowed for milling.

(b) Stiffeners need not bear against the flange angles but shall fit within 1/32".

8-07. CASTINGS. - The design of all castings shall be such as to minimize cooling stresses. Unfinished edges, ribs, and similar parts shall be cast with rounded corners and all inside angles shall have ample fillets. All bolt heads and nuts shall bear on finished seats at 90 degrees to the axis of the bolts. All castings shall be cleaned and fins and other irregularities removed. Castings to be attached to structural steel work shall have contact surfaces finished. Other surfaces shall be finished where indicated by good practice and by the design of the structure or device of which the casting is a part.

8-08. RAILS.

(a) Rails shall be straight in line, without twists, waves or kinks, and shall be smooth on the heads. Ends shall be milled square and the rails matched for height at the splices. If necessary to secure a smooth joint the bases may be machined 3" back from the splice. After matching, the rails shall be match-marked to insure assembly of the proper pieces in the field. Flame cutting of rails will be permitted, if machine guided, and provided 1/8" stock is left on material for finishing.

(b) Rail fittings shall not interfere with the free entrance or movement of the gate.

8-09. SHOP ASSEMBLY AND PREPARATION FOR SHIPMENT.

(a) The gate sections shall be completely assembled in the shop with holes for field connections reamed and bolted with turned bolts and with wheel assemblies, seals, air bubbler pipes, and lifting and coupling devices in place. After inspection and approval by the authorized representative of the contracting officer, the spliced parts shall be marked for identification, and the gate section taken apart for shipping. Each wheel assembly and each lifting and coupling device, with all connections and accessories, shall be individually boxed and marked for identification, as well as seals, lubrication pipes and fittings, and any other parts liable to damage in transit. The lifting beam shall be completely shop-fabricated and shipped in one piece with the lifting and coupling devices wedged and blocked to prevent movement or damage.

(b) Each dogging assembly shall be completely assembled in the shop and, after inspection and approval, the pieces shall be marked or tagged for field assembly and pieces liable to damage during transit boxed or crated.

(c) Track and guide rails shall have splices assembled in the shop and the spliced pieces match-marked for field assembly. Bolts, studs, pipe sleeves, clips, splice bars, and other small parts shall be boxed for shipment.

(d) Each box or crate shall contain all parts necessary for field connection of the equipment contained in it and shall have a list inclosed showing the entire contents.

(e) All marks shall be in accordance with approved assembly drawings, shall be clearly legible and so placed as to be visible when the part is being erected in the field. Each piece weighing more than one ton shall have the approximate weight marked thereon. Connecting parts assembled in the shop shall, before dismantling for shipment, be match-marked to facilitate field erection.

(f) The contractor shall prepare all materials and articles for shipment in such manner as to facilitate handling and to protect them from damage in transit and shall be responsible for and make good any and all damage due to improper preparation and loading for shipment. All threads and finished surfaces shall be protected as specified in Section IX.

8-10. TOLERANCES AND FITS.

(a) General. - Fits shall be in accordance with applicable requirements of the American Standards Association for Metal Fits.

(b) Gates and Lifting Beam. - The overall width of any gate section as represented by the distance between outside faces of the vertical end girder web plates measured at any point in the height of a gate section shall not vary from that called for on the drawings by more than 1/8" plus or minus. In an individual gate section, the maximum horizontal distance between outside faces of the vertical end girder webs shall not exceed the minimum by more than 1/8". The vertical end girder webs shall be straight and perpendicular to the skin plate.

The overall height of any gate section shall be as called for on the drawings with a tolerance of 1/4" plus on minus.

Each gate section shall be truly rectangular within the limits imposed by the tolerances permitted above.

The outside surface of the skin plate of each gate section shall be a true plane with a tolerance of 1/4" plus or minus, which tolerance shall include the standard mill variation in plate thickness.

The axis through the centers of each pair of wheel axle holes on a gate section shall be at 90 degrees to a plane perpendicular to the skin plate and containing the vertical center line of the gate, with a tolerance not exceeding no degrees, three minutes, thirty seconds ($0^{o}3'$-30") in any direction. All axle holes shall be on the "Wheel Center Line" as shown on the drawings with a tolerance of 0.020"either way.

The accuracy of workmanship shall be such that when the wheels are aligned, the distance from the contact surfaces of the wheel treads to the face of the vertical seal support shall not vary from the nominal dimension by more than 1/8" plus or minus.

The distance from the outer face of the vertical end girder web plate to the outer face of the support of the inner end of the axle at any wheel shall not vary from the nominal dimension by more than 1/64" plus or minus. The face of the support shall be spot-faced at the axle hole to furnish a bearing seat for the shoulder on the inner end of the axle.

Axle holes in both the end girder and in the inner axle support shall have free fit on the axle. Wheels shall be truly circular at the tread. The tread diameter shall be 30" with a tolerance of 0.01" plus or minus. The flange diameter shall be 32" with a tolerance of 1/16" plus or minus. Wheel treads shall be 4-1/2" wide with a tolerance of 0.005" plus or minus. Contour of the tread and flanges shall be suitable for use on the 175-pound crane rail used for the gate track. The distance from the center of the wheel tread to the outside of the hub cover shall be not greater than 5-3/4"; and to the outside of the bearing seal cover not greater than 5-1/2".

Holding bolts for the bearing seal and hub covers shall have free fit in the holes. The position of the centers of the lifting hooks and coupling devices on any gate section shall not vary more than 1/8" plus or minus from their nominal position as measured from the vertical center line of the gate or more than 1/16" plus or minus from their nominal position as measured from the downstream face of the skin plate. The position of the coupling devices on the lifting beam shall be on the longitudinal center line within 1/16" in either direction and shall not vary more than 1/8", plus or minus, from the nominal position as measured from the center line of the beam.

Guide pins shall have sufficient taper to enter the guide sockets with ample clearance while the gate sections, or gate section and lifting beam, are at the maximum limits of their sidewise movements in opposite directions; and shall have close enough clearance when entered to center the gate sections, or the gate section and lifting beam, and allow the coupling deveice to operate freely.

## SECTION IX - PAINTS AND PAINTING

9-01. GENERAL. - Unless otherwise specified or authorized, all paint materials shall conform to the current Federal Specifications wherever applicable. Where Federal Specifications are not applicable, material shall be as specified, or otherwise subject to the approval of the contracting officer. All paint, when applied, shall provide a satisfactory film and a smooth even surface, except when sand reinforced, and undercoats shall dry without excessive gloss, suitable for the proper application and adhesion of subsequent coats, as approved by the contracting officer. Where necessary, in the opinion of the contracting officer, to suit the conditions of surface, temperature, and weather existing at the particular time of application, the packaged paint may be thinned by the addition of not more than one pint per gallon of mineral spirits immediately prior to application, provided that in no case shall the viscosity of the paint be reduced to a point where the specified maximum coverages will be exceeded.

### 9-02. SURFACE CLEANING AND PREPARATION.

(a) Cleaning. - All ferrous surfaces to be painted shall be thoroughly cleaned of all millscale and other foreign substances to base metal by sandblasting or any other method approved by the contracting officer.

(b) Protection of Surfaces. - Care shall be taken to adequately protect all machinery parts, threads, and finished surfaces during cleaning and preparation.

(c) Inhibition. - All surfaces cleaned by sandblasting or equally effective method, shall be treated with a chemical rust inhibitor (paragraph 9-06). As soon after cleaning as practicable, and prior to formation of any forms of corrosion from atmospheric moisture, or other causes, the inhibitor shall be applied by brush and permitted to dry. This chemical inhibitor however, shall be applied only under conditions such that the temperature of the surfaces to which applied and the air in contact therewith, are between 50 degrees F. and 110 degrees F. in order to insure proper chemical reaction with the metal. After drying, any unneutralized reactive residue on the surfaces shall be removed by thorough wiping with wet cloths and the surfaces redried. The inhibited surfaces shall then be thoroughly brushed with a broom to remove the dry dusty reaction product and be given a standard priming coat of paint, as indicated, as soon thereafter as practicable, but in any event prior to deterioration or destruction of the inhibited surface. Should the inhibited surface be damaged or destroyed at any point by any means whatsoever the surfaces shall be cleaned and retreated in approved manner prior to application of the paint.

### 9-03. PAINT APPLICATION.

(a) All painting shall be done in a neat, thorough, and workmanlike manner. Except where otherwise specified or specifically directed, all paint coats shall be applied by either brush or spray in such manner as to produce an even coating of uniform thickness completely coating all corners and crevices. All painting shall be done by thoroughly experienced workmen. Care shall be excerised during spraying to hold the nozzle sufficiently close to the surfaces being painted to avoid excessive evaporation of the volatile constituents, and loss of material into the air. Paint shall be applied only to surfaces that are thoroughly dry and only under such combination of humidity and temperatures of the atmosphere and surfaces to be painted as will cause evaporation rather than condensation. A practical test is to wipe a damp cloth on the surface to be painted. If the moist streak dries promptly, conditions conducive to evaporation prevail. In no cases shall any paint be applied to surfaces upon which there is frost or moisture condensation, or during rainy or misty weather, without suitable protection as approved by the contracting officer. Painting during unfavorable weather conditions shall be carried on under a protective covering. While any painting is being done, the temperature of the surfaces to be painted and of the atmosphere in contact therewith shall be maintained at or above 50 degrees F. All paint when applied shall be approximately (within fifteen degrees of) the same temperature as that of the surface on which it is applied. Where protection is provided for paint surfaces, such protection shall be preserved in place until the paint film has properly dried and removal of the protection is authorized by the contracting officer. Working parts, hardware, and other surfaces not required to be painted shall be cleaned and protected to the satisfaction of the contracting officer.

(b) Coverage. - The surface area covered per gallon for each type of paint specified shall be not greater than 425 square feet per gallon.

## 9-04. PRIMING COATS.

(a) Unpainted surfaces. - Non-ferrous metal-coated surfaces, machined surfaces, surfaces requiring welding, and surfaces which will be in riveted contact shall not be painted. All other ferrous surfaces, unless otherwise specified shall receive one priming coat of Synthetic Red Lead Primer.

(b) Structural Parts shall receive one shop priming coat.

(c) Machinery and Mechanical Equipment (except threads and finished surfaces) shall receive one shop-priming coat.

(d) Exterior Electrical Equipment shall receive one shop-priming coat, except that enclosing cabinets and cases shall be given two shop-priming coats on the inside and one shop-priming coat on the outside. All cast metal surfaces requiring painting shall be smoothly finished with an approved filler prior to the application of paint.

(e) Machined Surfaces shall immediately after final inspection be thoroughly cleaned of all foreign matter and coated with a heavy film of Rust Preventive Compound, U. S. Army Specification 2-84A.

(f) Screw Threads shall be protected by a coating of heavy oil.

## 9-05. PAINTS AND PAINT FORMULAE.

(a) General. - Paints shall have the composition as indicated below or as otherwise approved by the contracting officer. All paints shall be guaranteed by the manufacturer not to gel, liver, or thicken deleteriously or form gas in a closed container within a period of one year from date of manufacture.

(b) Processing of Paints.

(1) Except where otherwise specified or authorized, all paint shall be made by grinding together dry or paste pigments and a liquid vehicle to form a smooth paint that will flow freely and will not settle or react

deleteriously in containers.

(2) Grinding shall produce a fineness such that coarse particles and skins will not exceed 1.5 percent (total residue left on No. 325 mesh screen, based on pigment). The grinding shall be done in a roll or pebble mill at temperatures that will not cause polymerization.

(3) Skinning shall be negligible after exposing 6 ounces of paint in a tightly closed 8 ounce glass container to sunlight for a total time of 24 hours.

(4) The resulting paint shall have satisfactory brushing and leveling properties, shall set to touch in not less than one hour nor more than four hours, unless otherwise specified, and shall provide a satisfactory film and a smooth even surface without undue gloss, suitable for proper application and adhesion of subsequent paint coats, as approved by the contracting officer. Sufficient suitable driers shall be added to make the paint dry hard within 18 hours.

(5) In view of potential variations resulting from variable processing equipment and technique, the manufacturer may be allowed, where necessary to product the specified viscosities, to make slight changes in formula proportions, subject to specific approval of the contracting officer.

(c) Synthetic Red Lead Primer, shall be composed of materials conforming, where applicable, to the specified requirements and mixed in the proportions as follows:

| | |
|---|---|
| Red Lead | 16.5% by weight |
| Iron Oxide | 38.2% |
| Zinc Yellow | 5.5% |
| Diatomaceous Silic | 6.0% |
| Vehicle (see par. 9.07) | 28.0% |
| Thinner | 5.8% |

The paint shall have a consistency of flow of between 25 and 40 seconds through the 0.15 inch diameter orifice of a standard consistency cup when tested in accordance with the procedure specified in paragraph 9 and 10 of A.S.T. M., Specification D 333-37 for "Methods of Testing Nitrocellulose Clear Lacquers and Lacquers Enamels." It shall have satisfactory brushing and leveling properties, shall set to light touch in not less than 2 hours nor more than 5 hours, and shall dry hard for recoating in not more than 18 hours, when tested in accordance with paragraph P-2d of Federal Specification TT-V-81a, entitled "Varnish; Mixing (for) Aluminum Paint." The vehicle shall be a synthetic resin varnish consisting of a phenol formaldehyde resin with the necessary oils and volatile thinners to produce elasticity, water-proofness, adherence, and durability in the finished paint film. It shall meet the detailed requirements of paragraph 9-07.

9-06 CHEMICAL RUST INHIBITOR, to be used where specified or required, shall be an approved compound of water, a wetting agent, a viscosity agent, phosphoric acid, and sodium dichromate. The concentration of the solution at the time of application shall be such that the Orthophosphoric acid ($H_3PO_4$) content shall be between 7.0 and 9.0 per cent (by weight) and the Sodium Dichromate approximately 0.75 percent. Commercial chemical rust inhibitors of composition somewhat different from this may be acceptable in lieu thereof, subject to approval by the contracting officer of results of approved tests showing that the inhibitor, when applied in accordance with instructions of the manufacturer, will identically affect ferrous surfaces as the specified compound in the following ways.

(a) Chemically react with rust and surface metal to etch the surface, form a dull greyish coating of iron-chromate-phosphate, and produce a rust-inhibited surface receptive to the firm bonding of the priming paint.

(b) After intially being thoroughly dried, the inhibited surface shall show no deleterious rusting when subjected to light, rain or to other dampening agency for a period of not less than 4 hours.

(c) Leave no unneutralized active chemicals on the surface.

9-07. PHENOLIC RESIN VARNISH VEHICLE shall conform to the following requirements:

(a) Oil resin ratio shall be 33 gallons of oil to 100 pounds of resin.

(b) Shall be clear and transparent and entirely free from resin, estergum, or other non-phenolic resins. Not less than 50 percent by weight of the vehicle shall consist of non-volatile oil and resin.

(c) The resin content shall be 100 percent para phenyl phenoformaldehyde condensate similar and equal to Bakelite BR 254, and shall conform to the current U.S. Navy Department Specification 52R10 entitled "Resin Phenol-Formaldehyde."

(d) The volatile thinner shall contain not more than 80 percent mineral spirits and not less than 20 percent high flash coal tar naphtha or high flash hydrogenated petroleum naphtha and shall be free from oxic hydrocarbons such as benzol.

(e) The oil content shall be ternary oil mixture composed of 40% linseed, 30% liquid oiticica, and 30% "dehydrated" castor oil.

(f) The flash point shall be not below 30 degrees C. in a closed cup tester.

(g) Shall pass a Kauri Reduction Test of 120 percent, using the method described in paragraph F-2g, Federal Specification TT-V-81, for "Varnish, Mixing (for) Aluminum Paint."

(h) Shall show no skinning after 48 hours in a 3/4 filled, tight container.

(i) Flow-out films on tin plate panels dried 72 hours shall withstand immersion in cold water for 96 hours, and in distilled water at 200 degrees F. for 7 hours without showing more than a slight haze which shall disappear within one hour, and shall show no other signs of deterioration. The panel shall be allowed to dry and cool for 15 minutes after removal from hot water and shall then be inspected for signs of failure.

9-08. PIGMENTS.

(a) Carbon Black shall conform to either Federal Specification TT-B-601, entitled "Boneblack; Dry, Paste-in-Japan, Paste-in-Oil" or Federal Specification TT-L-71 entitled "Lampblack; Dry, Paste-in-Japan, Paste-in-Oil."

(b) Lead Titanate shall be similar and equal to Titanox "L" as manufactured by the Titanium Pigment Corporation.

(c) Red Lead shall conform to Federal Specification TT-R-191a (97) percent Grade for "Red Lead; Dry and Paste-in-Oil."

(d) Iron Oxide shall contain not less than 98 percent $Fe_2O_3$ and shall not contain any organic coloring matter.

(e) Diatomaceous Silica shall be an approved commercial grade.

(f) Zinc Yellow shall contain not less than 40 percent $CrO_3$. It shall be a basic zinc potassium chromate, soluble in acetic acid, free from lead compounds, and containing no added zinc oxide, and shall be stable or non-reactive with the pigments and vehicles specified.

(g) Titanium Dioxide shall be similar and equal to either "T-Pure O" as manufactured by Krebs Pigment & Color Corporation or "Titanox NC" as manufactured by the Titanium Pigment Corporations.

## 9-09. THINNERS AND SOLVENTS.

(a) Mineral Spirits shall have the following properties:

Gravity - - - - - - - - - - - - - - - - - - - - - - - 43-47 degrees Baume
Flash Point (Closed cup) - - - - - - - - - - - 100 degrees F. Min.
Initial Boiling Point - - - - - - - - - - - - - - 300-310 degrees F.
End Point - - - - - - - - - - - - - - - - - - - - - - 405 degrees F. Max.
A.S.T.M. Copper Strip Test - - - - - - - - - - - Negative
Solvency (Kauri-Butanol) - - - - - - - - - - - - 41 cc(a) 77 degrees F. Min.

(b) Dipentine shall have the following properties:

| | Maximum | Minimum |
|---|---|---|
| Specific Gravity at 15.5 degrees C. | 0.854 | 0.845 |
| Refractive Index at 20 degrees C. | 1.477 | 1.472 |
| Unpolymerized Residus (percent) (38N $H_2SO_4$) | 2.5 | |

A.S.T.M. Diltillation Range:
5% Distilling at - - - - - - - - - - - - - 173 degrees C.
10% Distilling at - - - - - - - - - - - - 175 degrees C.
97% Distilling at - - - - - - - - - - - - 188 degrees C.
Color-Lovibond 500 amber - - - - - - - - - - - -3
Appearance: Clear and free from suspended matter.

(c) Toluol shall conform to U. S. Navy Department Specification 52T7 entitled "Toluene (Toluol)", except that it shall have a solvency (Kauri-Butanol Method) of not less than 100 cc. at 77 degrees F.

(d) Xylol shall conform to A.S.T.M. Specification D364-36 for "Industrial Xylene (Xylol) or 'Solvent Naphtha'", except that it shall have the Solvency (Kauri-Butanol Method) of not less than 93 cc. at 77 degrees F.

(e) Normal Butyl Alcohol (Butanol) shall conform to A.S.T.M. Specification D304-33 for "Butanol (Normal Butyl Alcohol)."

(f) Ethylene Gycol Monoethyl Ether shall conform to A.S.T.M. Specification D331-35 for "Ethylene Glycol Monoethyl Ether."

## 9-10. MISCELLANEOUS MATERIALS.

(a) Oil, Linseed shall conform to Federal Specification JJJ-O-331 for "Oil; Linseed, Boiled," or JJJ-O-336, for "Oil; Linseed, Raw," as specified or required.

(b) Insulating Varnish, U. S. Navy Department Specification 52-V-13b, entitled "Varnish; Insulating, (for) Electrical Purposes."

(c) Creosote Paint for surface treatment of timber shall conform to Federal Specification TT-W-561a, entitled "Wood-Preservative: Creosote (for) Brush and Spray Treatment."

(d) Ortho-Phosphoric Acid ($H_3PO_4$), shall be commercially pure product, in liquid form, containing not less than 75 percent $H_3PO_4$.

(e) Sodium Dichromate, ($Na_2Cr_2O_7 \cdot 2H_2O$) shall be a commercially pure product in crystalline form containing not less than 85 percent $Na_2Cr_2O_7$.

9-11. INSPECTION.

(a) Unless otherwise specifically authorized, inspection of all materials for the paints and chemical rust inhibitor and the manufacture thereof will be made by a representative of the contracting officer. All samples of materials and of the finished processed products will be tested and analyzed for conformity with the specifications by the Government. The inspector will collect for testing, samples of each of the materials to be used in the manufacturing processes and will then seal the material containers until test results from the samples indicate that the various materials conform to specifications. He will witness the breading of the seals on the approved material containers and the compounding of the materials for the product being manufactured, will collect samples of the finished product for testing, and will witness the placing, sealing, and labeling of the finished product in containers for shipment. After the finished products have successfully passed the prescribed test, shipment of the sealed containers will be authorized.

(b) In the case of ready-mixed and packaged paints of standard manufacture, other than those specified by trade name, the contractor shall furnish a sample in the standard stock package, together with a certified copy of the complete chemical analysis, for test and approval by the contracting officer.

9-12. PAYMENT for all paint and painting will be included in the contract price for the respective metals or items painted.

## SECTION X

## INSPECTION AND TESTS

### 10-01. GENERAL.

(a) No item of equipment for which operation tests are herein specified shall be shipped from its assembly point until such tests have been satisfactorily performed in the presence of a representative of the contracting officer; or until specific authorization is made for the tests to be performed elsewhere.

(b) The contractor shall, at his own expense, furnish all material, equipment, and labor necessary for the tests and shall, when requested, furnish certified test reports to the contracting officer.

(c) The acceptance of any item of equipment shall not relieve the contractor of his responsibility for meeting all of the requirements of the specifications and shall not prevent subsequent rejection if such equipment is later found to be defective.

### 10-02. TESTS OF WHEELS

(a) Each wheel and axle shall be assembled complete with bearings and accessories, but without grease, and set up on a suitable support so that the wheel may be revolved on the axle. The wheels shall turn freely, consistent with the size and weight of the parts, and any indication of binding or excessive play shall be corrected. A dial indicator applied to the tread of the wheel when it is revolved shall indicate not more than 0.005 inch variation in a complete revolution of the wheel.

(b) Before assembling any of the wheels with the gates the contractor shall test one set of four wheel assemblies on a single special test axle, under both static condition and at a shaft speed of one-half revolution per minute for a period of four hours, under simultaneous test loads of 100,000 pounds, applied axially at a point near the wheel tread and 300,000 pounds applied radially. If any of the wheels, bearings, or other parts of the wheel assemblies fail to meet the requirements of these specifications under this test, the contracting officer or his representative may reject all of the affected parts, or order the test repeated such number of times as he deems necessary for him to determine the disposition to be made of such parts.

(c) The contractor shall test at least one finished roller bearing from each heat for ultimate strength. Failure of any roller to meet the requirements of paragraph 5.03 will be cause for rejection of all rollers made from the same heat or furnace charge.

(d) The contractor shall test one wheel assembly for tightness of gaskets and bearing seals with external atmospheric pressure and sustained internal pressure of 2.5 pounds per square inch absolute. Contact surfaces between seals and shafts may be greased or wet for this test. Rise in internal pressure due to leaks shall not exceed one pound per square inch in two hours.

(e) These tests may be omitted upon specific waiver by the contracting officer, provided the contractor submits satisfactory evidence that the wheel assemblies he proposes to furnish have successfully withstood tests of a similar nature both as to magnitude of test loads and in the manner of their application.

### 10-03. TESTS OF LIFTING AND COUPLING DEVICES. -

(a) The complete assembly of the lifting and coupling devices for each end of each gate, shall be subjected to a proof tension test of 385,000 pounds with the loads applied at the upper hook and at the hook links as they would be applied during operation. Each whole assembly shall also be tested in tension to 175,000 pounds with the loads applied at the hook links and at the ends of the wedge in place the slot in the upper hook. The position of the parts during the tests shall be the same as they would be if installed in the gate. After the tension tests the devices shall be installed in the gates and tested for satisfactory operation under simulated operating conditions. Any permanent deformation due to the test loads shall not be great enough to affect the simultaneous operation of the devices or to appreciabley reduce proper clearances.

(b) Each lifting hook and pin of the bottom gate sections shall also be tested in tension to 385,000 pounds with loads applied as they would be applied during operation.

(c) The lifting and coupling device in each end of the lifting beam shall be tested similarly with a load of 385,000 pounds.

10-04. TESTS OF DOGS. - Each gate dog shall be mounted on its pin in a manner simulating operation conditions and tested separately with a load of 300,000 pounds applied at the seat.

# IROQUOIS DAM

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# SPECIFICATIONS
For
GANTRY CRANES

## SECTION II DESCRIPTION

2-01. EQUIPMENT REQUIRED. - The equipment required under this contract consists of:

(a) Two electrically operated gantry cranes designated as "Crane No. 1" and "Crane No. 2" on the drawings.

(b) All tools, accessories and other equipment required for the operation and maintenance of the cranes.

2-02. OPERATION. - The gantry cranes will be used for operation of the spillway gates in the slots between the upstream and downstream crane rails, for transporting the gates along the dam, and for miscellaneous service on the dam. The gates will be handled by means of a lifting beam, furnished by the Government, which will contain a mechanism at each end so designed that the crane operator may connect the beam to or disconnect it from the lifting hooks on the gates.

## SECTION III - DESIGN

3-01. GENERAL. - The contractor shall assume full responsibility for a coordinated and adequate design fulfilling the requirements of these specifications and conforming to the best engineering practice. The design and construction shall conform to all usual safety requirements and safety guards shall be provided where necessary for the protection of operators or others from injury.

3-02. EXTERIOR APPEARANCE. - The exterior appearance of the cranes shall be as nearly as practicable as shown on the drawings. The sections of members and details of framing shall be such that all external surfaces shall be smooth in appearance and free from exposed structural shapes and castings. Where this result cannot be conveniently attained, removable copper-bearing sheet steel covering not less than 1/8" thick shall be provided. All members, including box girders, shall be designed so that inside surfaces may be inspected, cleaned and painted; and access holes with flush covers shall be provided where necessary.

3-03. FRAMING. - The structural frame shall be rectangular in plan with each truck skewed at a fixed angle with the sill and with its center line tangent to the curve of the gantry track rail at the center of the portal leg. The portals spanning between the gantry rails shall be designed as rigid frames and shall have sufficient clearance at all points to clear the gate sections when they are dogged in their highest positions in the slots. The side frames shall consist of upper and lower sills with bracing as shown on the drawings. The cab mounting shall be at the east end of Crane No. 1 and at the west end of Crane No. 2 with the cranes in position on the runway. A platform shall be provided on each crane at the downstream lower sill for access to the gate snubbers. Ladders shall lead from the platform down to the top of the runway girder and up to the cab floor level. The horizontal frame at the upper sills and the connections between the portal legs and the horizontal girders shall be adequately braced and gussetted to meet conditions of paragraph 3-05(d).

3-04. CAPACITIES AND SPEEDS.

(a) Main Hoist. - The main hoist shall have a nominal capacity at the lower sheaves (on two drums) of 225 tons with a hoisting speed of 2 feet per minute and with the trolley stationary. The maximum estimated load which the trolley will be required to transport on the trolley runway is 115 tons.

(b) Auxiliary Hoist. - The auxiliary hoist shall have a nominal capacity of 10 tons with a hoisting speed of 15 feet per minute.

(c) Gantry and Trolley Travel. - The gantry travel speed shall be 75 feet per minute and the trolley travel speed shall be 15 feet per minute. The gantry travel motors shall have such capacity that either crane, when loaded with a gate section weighing 115 tons (including the lifting beam), may be used to tow the other crane similarly loaded a distance of 1000 feet against a wind pressure of 10 pounds per square foot with a temperature rise of any motor not exceeding 50° F.

3-05. LOADS.

(a) General. - All parts of the crane shall be designed to sustain the combinations, listed under 3-05(b) below, of the following loads with due allowance for eccentricity and without exceeding the unit stresses hereinafter specified:

(1) The dead load shall include the weight of the gantry structure and the trolley and all permanently attached mechanical and electrical parts.

(2) The design live load for the trolley shall include the rated load of 225 tons, the dynamic forces of acceleration and retardation, and tension in moving ropes. For the live load on the gantry structure, the following loads shall be considered:

a. The design live load on the trolley plus the weight of the trolley with the trolley in position for lifting a gate is either the upstream or downstream slots.

b. The weight of the trolley with a load of 115 tons as a moving load at any point between the limits shown on the crane drawings for gate operation.

c. Impact allowance for live loads shall be 25%.

(3) The trolley tractive force shall be taken as 10% of the weight of the trolley with a load of 115 tons and shall be considered as applied at the top of the trolley rails.

(4) The gantry bridge tractive force shall be taken as 10% of the weight of the entire loaded crane, which shall include the trolley and a suspended load of 115 tons at any point on the trolley runway for gate operation. For gate operating condition, the tractive force shall be considered as distributed in the ratio of 3/4 to the downstream side frame and 1/4 to the up-stream side frame.

(5) The wind load shall be considered as acting on the projected area of the crane structure and the suspended load. The wind area of a spillway gate section shall be taken as 1280 square feet for wind acting normal to the gantry track and 125 square feet for wind acting parallel to the gantry track. The center of pressure of the wind on the suspended load shall be assumed at 12 feet above the gantry runway rails. The wind intensity shall be taken as given in the various load combinations specified below.

(6) The live load on the roof of the trolley runway housing shall be assumed as 35 pounds per square foot.

(7) The live load on floors and platforms shall be assumed as 50 pounds per square foot.

(b) Load Combinations. - The following load combinations shall be considered:

Case I: For the gantry in operating condition, a wind load of 10 pounds per square foot in combination with dead and live loads, impace and traction forces.

Case II: For the gantry in static condition, a wind load of 30 pounds per square foot in combination with dead and live loads.

Case III: For the gantry in operating condition, a combination of dead and live loads and the forces produced by collision with the track stops with the loade gantry traveling at full speed with power off.

Case IV: For the gantry in operating condition, a combination of dead load and the forces produced by the rated break-down torque of the hoist motor acting through one drum only.

Case V: For the gantry in static condition, a wind load of 40 pounds per square foot in combination with dead load only.

(c) Stability. - The crane shall have a factor of safety against overturning of at least 2 under any condition of loading.

(d) Unbalanced Tractive Effort. - The horizontal structural frame at the upper sills shall be adequate to prevent skewing under the actual unbalanced tractive effort caused by the two motors on one side driving the crane, loaded with a spillway gate, against a wind pressure of 10 pounds per square foot.

3-06. UNIT STRESSES.

(a) For Case I, the unit stresses in structural parts shall not exceed those specified by the American Institute of Steel Construction's "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings", as revised in 1936, except as otherwise modified herein, and except that all stresses shall be proportionately reduced to conform to a basic stress of 16,000 instead of 20,000 pounds per square inch for tension in net section.

(b) For Cases II and III, the resulting unit stresses shall not exceed 125% of those allowed for Case I.

(c) For Case IV, the resulting unit stresses shall not exceed 90% of the elastic limit of the materials involved.

(d) For Case V, the stability requirement of paragraph 3-05(c) shall be met.

## SECTION IV - STRUCTURAL DETAILS

4-01. GENERAL. - The gantry structures and trolley frames shall be built of structural steel shapes and plates. Shop connections may be either riveted or welded. Filed connections shall be riveted. Webs of beams and channels shall be not less than 1/4 inch thick. All other structural material except sheathing, hoods and other covers shall be not less than 3/8 inch thick.

4-02. WELDED CONNECTIONS. - In the design of welded connections the following unit stresses in the weld throat shall not be exceeded:

| | |
|---|---|
| Shear | 11,300 pounds per square inch |
| Tension | 13,000 " " " " |
| Compression (on butt-welds) | 15,000 pounds per square inch |

Allowance shall be made for ecentricity in the section of the base metal parts, except that for fillet welds no allowance need be made for any bending couple caused by resultant stresses in the two fused legs of the weld. Stresses in fillet welds shall be considered as shear for any direction of the applied stress. Connection parts welded to form joints between members shall be designed to transmit the calculated stresses without exceeding the working stresses in the members. Where continuous welds are not required the welds shall be spaced not more than 18 inches apart in any continuous line, and on compression members such spacing shall not exceed 16 times the thickness of the thinnest metal. No weld shall be less than 2 inches long exclusive of craters. Overhead welding shall be used only where unavoidable.

4-03. PLATE GIRDERS. - Plate girders shall be proportioned by the moment of inertia of the net section. Wheel loads applied to flanges through rails shall be considered as distributed over a distance along the flanges not exceeding 36 inches. The rails shall not be considered as taking any portion of the top flange stresses. Girders of box section shall be provided with internal diaphragms at points of concentrated loading and at intervals of not over five feet throughout the length of the girder. Full depth diaphragms shall be used at intervals of not over ten feet. Other diaphragms shall have a depth not less than their width. Diaphragms shall be faced to insure full bearing of top flange over plates, and end diaphragms shall be also faced for full bearing at the bottom. Diaphragms shall be riveted to both webs with sufficient rivets to transmit concentrated loads and with a pitch not greater than 6 inches.

4-04. LADDERS, PLATFORMS, WALKWAYS AND HAND-RAILING. - Ladders, platforms and railings shall be provided at all locations shown on the drawings or required by the design. Ladders shall be not less than 14 inches wide, with 7/8" diameter rungs spaced 12 inches on centers between 2 inch by 1/4 inch side bars. Platforms and walkways shall be floored with non-slip steel plate and provided with toe plates at all open edges. Walkways shall have a minimum net clearance of 24 inches. Hand-railing shall be provided along the open sides of all platforms and walkways where praticable. Railings shall be 42 inches high with an intermediate rail between the floor and top rail. Rails and posts shall be standard 1¼ inch pipe with standard malleable iron railing fittings.

4-05. TROLLEY RUNWAY HOUSING. - The trolley runway housing shall be of copper-bearing steel plates, 3/16 inch thick, thoroughly braced with steel framing to withstand all loads and provided with ample louvres for ventilation as shown on the drawings. Where necessary for the convenient removal of machinery units, removable sections shall be provided in the housing. In addition, an opening 30 inches square shall be located at a convenient place in the top of the housing for access to the roof. This opening shall be provided with a water-tight cover which shall be readily removable from the inside and with suitable means for reaching the opening from the trolley or walkway.

4-06. OPERATOR'S CAB. - The steel framing and supports for the operator's cab shall be of ample strength to support the weight of all equipment and shall be braced to withstand wind loads as well as forces and vibration due to operation of the crane. The sheathing shall be 1/8" copper-bearing steel plates secured to the framework in a manner to make a weatherproof enclosure with a smooth exterior surface. Means shall be provided for installation or removal of equipment.

Sash shall be provided at locations shown on the drawings. The movable sash on the west end of Crane No. 1 and east end of Crane No. 2 shall swing inward, the sloping sash at the controllers shall be fixed and the sash in the upstream and downstream ends of the cab shall swing outward. All movable sash shall be of the commercial projected type. Glazing for the upstream and downstream end windows and for the cab doors shall be clear, polished wireglass, 1/4 inch thick. All other glazing shall be clear, shatterproof, polished plate glass, 1/4 inch thick. All glazing shall be done from the inside by means of weather-tight glazing strips. Putty shall not be used.

The cab floor shall be covered with approved cement-asbestos board not less than 3/4 inch thick. The roof, walls and floor of the cab shall be insulated with rock wool of 4" minimum thickness.

4-07. COLLECTOR ARMS. - The collector arms shall be of structural steel and located at the west portal frame on the upstream side of Crane No. 1 and on the east portal frame on the upstream side of Crane No. 2 as shown on the drawings. The connections to the crane frame shall be bolted so that the arm may be readily removed. The arm and connections shall be sturdy in design to prevent excessive deflection or distortions due to drag of the collector shoes or motion of the crane. The detail at the lower end of the arm shall be such that the width of opening in the conductor slot covering may be as small as possible and the conductors may be above the opening.

## SECTION V - FABRICATION OF STRUCTURAL STEEL

5-01. GENERAL. - Fabrication of structural steel shall be in accordance with Section 25 of the "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings" as adopted by the American Institute of Steel Construction, and revised in 1936, except as noted in paragraphs 5-02 to 5-05 inclusive.

5-02. HOLES. - For minor parts, holes may be punched full-size in material 3/4 inch or less in thickness, but shall be drilled full size in material more than 3/4 inch in thickness. For all other parts, holes shall be sub-punched and reamed after assembly in material 3/4 inch or less in thickness, but in material more than 3/4 inch in thickness shall be drilled full size after assembly, or drilled 1/8 inch less than the nominal rivet diameter before assembly and reamed full-size after assembly. Holes for turned bolts shall have a Class 4 fit with the finished shanks of the bolts as defined by Bulletin B4a-1925 of the American Standards Association.

5-03. PUNCHING, DRILLING AND REAMING. - For sub-punching, the diameter of the punch shall be 3/16 inch smaller than the nominal diameter of the rivet. For punching full-size, the diameter of the punch shall be 1/16 inch larger than the diameter of the rivet. In each case, the diameter of the die shall be not more than 3/32 inch larger than the diameter of the punch.

5-04. FIELD RIVETS AND ERECTION BOLTS. - Field rivets shall be furnished in the amount of 15% plus 10 rivets in excess of the nominal number of each size and length required. The contractor shall also furnish all necessary temporary erection and fitting-up bolts required for field erection.

5-05. WELDING

(a) Preparation. - Pieces to be joined by fusion welding shall be accurately cut to size and formed prior to welding. All forming shall be done by pressure and not by blows. The preparation of the edges to be joined shall be such as to insure thorough and complete penetration; if necessary the edges shall be planed. The relative positions of the pieces at the time of welding shall be such that the cooling of the weld will not set up excessive strains in the weld or the parent metal. All pieces to be welded shall be free from rust, paint, or other foreign matter for a distance of not less than 1/2 inch back from the welding edge.

(b) Welding Procedure. - All welding shall be done by the electric arc method, using a process which will exclude the atmosphere from the molten metal. The welding shall be done in a manner that will produce complete fusion with the parent metal. The welded joints shall be reasonably smooth and free from grooves, depressions, and other irregularities. All welding unless otherwise specified shall be in accordance with the applicable current codes, specifications, and recommended practices of the American Welding Society.

The contractor shall assign to each welder an identifying number, letter, or symbol which shall be stamped on the pieces adjacent to and at intervals of not more than 3 feet along the welds which he makes either by hand or by machine.

(c) Stress Relieving. - Welded parts shall be stress relieved by heating uniformly in an annealing furnace to temperature between 1100° and

1200° F. Each piece shall be brought slowly up to the specified temperature, held at that temperature for a period of time proportioned on the basis of at least one (1) hour per inch of maximum thickness, and then allowed to cool slowly in a still atmosphere. At no time during the stress relieving period shall there be a temperature differential greater than 200° F. in the piece being treated. Each piece shall be properly supported in the furnace to prevent distortion. Heating of any part of the structure after stress relieving will not be permitted. Stress relieving of welds in minor parts may be omitted upon specific approval by the contracting officer.

(d) Qualification of Welders. - The contractor shall furnish to the contracting officer satisfactory evidence that each welder to be employed on the work has within one year of the date of this contract satisfactorily performed the qualification tests prescribed by the American Welding Society in its latest "Code for Fusion Welding and Gas Cutting in Building Construction," using the detailed procedure to be followed in actual production under this contract. The contractor shall require any welder to repeat these tests when in the opinion of the contracting officer the work indicates a reasonable doubt of the welder's efficiency.

## SECTION VI - MECHANICAL EQUIPMENT

6-01. GENERAL. - All mechanical equipment shall be substantial in design, easity erected, inspected, adjusted, painted and taken apart. All mechanical parts shall be designed to withstand all dead and live loads with a factor of safety of not less than 5, without allowances for impact, acceleration, or retardation, and also shall be proportioned to withstand additional loads produced by the rated breakdown torque of the motors without the resulting stresses exceeding 90% of the elastic limit of the material involved.

Castings shall be cleaned and all fine and other irregularities removed. Castings to be attached to structural steel work or to other castings shall have their contact surfaces finished. Unfinished edges of castings, ribs, and similar parts shall have rounded corners and all inside angles shall have proper fillets.

Bolt heads, nuts, and washers shall bear on finished seats perpendicular to the axis of the bolts.

Machinery shall be mounted on rigid self-contained cast steel, or welded steel frames or bedplates or on structural steel supports. The fastenings shall be adequate to hold the parts in place and alignment under all conditions of service. Turned bolts, dowels, or equivalent, shall be used to secure equipment in place. The deflection of machinery supports under maximum load shall be so limited as to cause no injurious misalignment of the equipment.

6-02. TRUCKS AND WHEELS. - Each gantry truck shall have four wheels and shall be equalized so that each wheel will carry its proportion of the leg load. The trolley shall be mounted on 4 trucks with 2 wheels each. Provision shall be made so that in the event of damage to any wheel, axis, or journal, the drop of the truck will not exceed one inch, and it shall be possible to remove readily the damaged part. Each end of each gantry truck shall be provided with substantial track clearers which shall be effective in both directions of travel and shall extend below the top of the rail on each side. Trucks shall also be provided with safety lugs extending below the top of the rail on both sides to prevent the truck leaving the rail. Bolted connections of truck shall have contacting surfaces machine finished.

A bracket to support the truck drive motor shall be provided at the inner end of each truck. Motor and machinery shall be concealed by copper-bearing sheet steel as shown on the drawings.

All truck wheels shall be double flanged, rolled steel. They shall be of sufficient size to withstand adequately the maximum standing and rolling loads and shall be machined to limit the side movement to 3/4 inch on the head of a 175 pound crane rail, section number 175-418. The trolley truck wheels shall be not less than 24 inches tread diameter, and the gantry truck wheels shall be not less than 27 inches tread diameter.

6-03. TRUCK AXLES. - Truck axles shall be steel forgings, accurately turned all over, and ground and polished at the journals. Journals shall be of sufficient size to withstand adequately the maximum standing and rolling loads. All axles shall be forced into the truck wheels with a pressure of not less than 8 tons per inch of axle diameter. The driving wheels shall be keyed to the axles in addition to the forced fit.

6-04. TRUCK JOURNAL BOXES. - Truck journal boxes shall be gray iron castings machined to fit rectangular finished seats on the wheel trucks and bored and fitted with "Sealed" type phosphor bronze bearing bushings. The bushings shall be provided with openings at the bottom fitted with "Stapax" or approved equal, lubricating pads. The outer ends of the bushings shall be closed by bronze covers cast integral and approved seals closely fitted around the axles. Provision shall be made to prevent the busings from turning in the box. The boxes shall be provided with oil cellars with covers to permit renewal of lubricant and lubricating pad. Suitable oil drain plugs shall be provided in the bottom of the oil cellars. All bearings shall be drip-proof, water tight and interchangeable.

6-05. GANTRY DRIVE. - The gantry shall be driven by four indentical gear motors mounted one on each truck at the inner end; and the driving mechanism shall be arranged to drive the pair of truck wheels nearest the motor. The driving mechanisms shall be so designed and shall have such capacity that the movement of the crane will be steady and the crane structure free from vibration or racking while moving at full speed and with full load against a wind pressure of 10 pounds per square foot of exposed surface. The combined capacity of the motors shall be sufficient to accelerate the loaded crane from standing to full speed against a wind pressure of 10 pounds per square foot of exposed area of crane and gate in not more than 20 seconds.

6-06. TROLLEY DRIVE. - The trolley shall be driven by means of a motor mounted on a trolley frame and connected to one pair of driving wheels on each end of the trolley through gearing and shifting, substantially as shown on the drawings. The trolley drive shall be so designed that the travel will be steady and free from vibration or racking in any part under all conditions.

6-07. RAIL CLAMPS. - A manually operated locking device shall be provided by means of which the gantry may be secured to the runway, to hold the unloaded crane against a wind pressure of 40 pounds per square foot.

6-08. GATE RETAINING LATCHES. - Gate latching devices shall be furnished to lock the gate securely against sidewise and endwise motion while it is being carried along the deck. The latches shall hold the gate in such a manner that the horizontal loads acting on the gate will be transmitted to the gantry structure.

6-09. LIFTING BEAM CENTERING PINS. - A pair of centering pins shall be mounted on structural steel frames on the under side of the trolley for the purpose of engaging the guide sockets in the top of the lifting beam. The pins shall be tapered to suit the guide sockets in the beam and shall have sufficiently close clearance in the sockets when the beam is at its highest position to hold it in place without excessive lateral movement. The pins and frames shall be designed to transmit to the trolley its proportion of the maximum assumed wind load on a gate section when the gate section is secured to the latching devices on the lower sills.

6-10. - MAIN HOIST. - The main hoist shall be of the single motor, double drum type mounted on the trolley framework.

Speed reducers shall conform to the specifications for Heavy Duty Speed Reducers adopted by the American Gear Manufacturers Association and shall be rated in accordance with the formulae recommended by the association. Flexible couplings shall be of standard or disengaging type, and of ample size and capacity for the service and loads.

6-11. AUXILIARY HOIST. - The auxiliary hoist shall be of the single motor, single drum type mounted on the trolley framework.

Speed reducer and flexible couplings shall be as specified in 6-10.

6-12. GEARING. - Gears may be of the herringbone, spur or worm type. Herringbone gears shall be of standard involute form, with 20-degree pressure angle. Proportions of involute gears shall be according to the current recommendations of the American Standards Association. Worm gears shall be of involute type. No spur gear pinions shall have less than 15 teeth. No motor pinions shall have less than 17 teeth.

Stresses in gears shall be computed by the Lewis formula, using the Barth formula for correction for speed. All gears shall be designed to take the entire pitch line load on one tooth. All pinions shall be annealed carbon-steel forgings, and all gears shall be carbon-steel castings, except the ring gears on main hoisting drums, which shall be carbon-steel forgings. In worm gearing the gear shall be of phospher gear bronze, and the worm a steel forging. Gears shall outmesh on top, where practicable. All gear teeth shall be cut from the solid.

6-13. BEARINGS. - Bearings shall be of the roller or ball type or shall have removable bronze linings. Shaft bearings shall be placed as close as possible to the points of shaft loading and shall be so designed that the bearing element may be easily replaced and that the shaft may be removed from the crane with its pinions and gears in position. Where divided bronze bearings are used the bearing caps shall be doweled and provision shall be made to hold linings effectively against rotation or changing position under load. The top half of grease lubricated split bearings shall be drilled and tapped for lubrication fittings. All linings, thrust washers and other surfaces requiring lubrication shall be grooved and open ends shall be sealed with approved grease retainers. All bearings shall be drip-proof and watertight.

Where bronze linings are used, the bearing area shall be such that the product of the load, in pounds per square inch, and the square foot of the rubbing velocity, in feet per second, will not exceed 900, but in no case shall the bearing pressure exceed 1300 pounds per square inch.

The minimum thickness of linings shall be as follows:

| Shaft Diameter | Lining Thickness |
|---|---|
| Less than 2½ inches | 1/4 inch |
| 2½ inches to 4 inches | 3/8 inch |
| 4 inches to 5½ inches | 1/2 inch |

Ball or roller bearings shall be of standard type and of the highest grade of manufacture. Sizes shall be in accordance with the manufacturer's tables for the loads and speeds involved with not less than 100 percent added to the calculated loads to determine the required capacity to provide for shock loads.

Ball or roller bearings shall be mounted in accordance with the best engineering practice for the application under consideration and shall be enclosed in oil-tight enclosures with means for excluding dirt and retaining lubricant.

6-14. DRUMS. - The hoist drums shall be of close-grained cast iron or of welded structural carbon steel. They shall be of heavy section and ribbed to sustain the concentrated loads due to rope tension. The thickness of the drum under the ropes shall be not less than 1½ inch if of cast iron or 1-1/4 inches if of welded steel for ropes over 1 inch in diameter, and not less than 1 inch if of cast iron or 3/4 inch if of welded steel for ropes 1 inch or less in diameter. Each drum shall have right and left hand grooves, turned from the solid, to receive the hoisting rope. The grooved length of the drums shall be sufficient to take the full run of rope for the maximum lift plus two turns at each end. The rope attachment to the drum shall be simple secure so that replacement of the rope may be made without dismantling the parts. Drums shall be pressed and keyed to the drum shaft; and shaft, gear and drum shall be in proper running balance. The drum gears shall be pressed and keyed to the drum body. The pitch diameter for the drums shall be not less than 30 times the outside diameter of the rope. The various parts of welded drums shall be fitted together by machine grooving, turning or boring before welding as may be necessary to secure accurate assembly.

6-15. MECHANICAL AND HYDRAULIC BRAKES.

(a) Main Hoist. - The drive of each hoist drum shall be equipped with a mechanical load brake which shall have capacity to hold 100% of the rated torque of the hoist motor, and which shall be designed to prevent the load from lowering unless the hoist motor is revolving under power in the lowering direction. Brakes shall preferably be of the type which utilizes the thrust of the worm gear in the speed reducer to produce pressure on friction disks, and which operate in conjunction with thruster brakes on motor shaft and driven disk. Brakes shall run in a bath of oil and shall be so arranged that all strain due to loads is taken from the motors when the brakes are applied. At the full speed lowering position of the controller the regenerative action of the hoist motor shall provide the braking effect.

(b) Gantry Travel. - A hydraulically operated brake shall be provided to control the gantry travel in both directions. This brake shall be actuated by a foot pedal in the operator's cab and shall develop a retarding torque at the revolving motor shaft equal to the motor's full load torque when the pedal is under a pressure of not more than 50 pounds. The operating conditions for the crane require that it be accurately and quickly spotted over the gate openings, and the brakes shall be adequate for this purpose.

6-16. ROPE SHEAVES. - Rope sheaves shall be solid rolled steel. The rope grooves shall be turned. Pitch diameter of rope grooves for all moving sheaves shall be not less than 27 times the diameter of the rope and for equalizing sheaves not less than 20 times the diameter of the rope. All sheaves shall be provided with anti-friction bearings or with phospher bronze bushings forced into the hubs and dowelled. The design of the lower sheave blocks shall suit the design of the lifting beams to be used with the crane. Adequate provision shall be made for lubrication of all sheaves.

6-17. WIRE ROPE. - All hoisting rope shall conform to Federal Specification RR-R-571, Type XXXIII, uncoated. No rope larger than 1-3/8 inches in diameter shall be used and if practicable, none over 1-1/4 inches. The ropes shall be of sufficient length to provide two extra turns on each drum plus adequate allowance for attaching to the drum.

6-18. SPRING BUMPERS. - The four corners of each crane shall be provided with spring bumpers to prevent injury to the crane, or to the loads being carried, by collision with the track stops or with the other crane. The two bumpers at each end of each crane shall be capable of bringing the crane to a safe stop when traveling in either direction at rated speed with a load of 115 tons and the power cut off, without excessive stresses in the structure or equipment and with a minimum plunger travel of 5 inches. The bumpers shall consist of suitable springs, steel cylinders, and rams and shall be fastened securely to the trucks.

Spring bumpers shall be provided on the trolley runway to limit the travel of the trolley in each direction as shown on the drawings. They shall be attached to the trolley girders and shall contact lugs on the trolley frames. The two bumpers at each end of the trolley runway shall have sufficient capacity to bring the trolley, traveling at rated speed with power off and with a load of 115 tons, to a safe stop in five inches.

6-19. COUPLING EQUIPMENT. - Adequate means shall be provided on both sides of the west end of Crane No. 1 and the east end of Crane No. 2 so that either crane, loaded or unloaded, may be towed or pushed along the runway by the other crane.

6-20. SHAFTING AND COUPLINGS. - Shafting shall be amply proportioned and supported and provided with adequate means to prevent longitudinal movement. All shafting 3 inches in diameter and larger shall be made from hot-rolled steel bars, turned and ground, with fillets of not less than 1/4 inch radius where changes of section occur, and shall be polished at the bearings. Shafting smaller than 3 inches may be made of cold-finished steel, if of uniform diameter, otherwise of hot-rolled steel bars. Flanged couplings of the rigid type shall be carbon-steel forgings with safety type flanges, finished all over and fitted with turned bolts. Couplings shall be strong enough to develop the full strength of the shafting which they connect, and shall be pressed and keyed to the shafting.

6-21. BOLTS AND NUTS. - All bolts, nuts, and studs, except fitting-up bolts, shall conform to the American Standards Association's requirements for semi-finished, washer-faced hexagon heads and nuts with cut threads, coarse thread series, Class 2 fit. Heads shall be of "American Standard, regular" and nuts shall be of "American Standard, heavy" proportions. Turned bolts shall meet all the requirements of bolt and nut specifications and in addition, the diameter of the shank shall be 1/16 inch larger than the nominal diameter of the thread and shall be turned truly cylindrical within the limits and tolerances of a Class 4 fit of the American Standard Association. Holes in the parts shall be correspondingly reamed. The unthreaded protion of the shank shall be 1/16 to 1/8 inch longer than the thickness of the connected members. Each bolt shall be provided with a washer 1/4 inch thick.

6-22. KEYS AND KEYWAYS. - Keys shall, in general, conform to the American Standards Association Specifications B17-1-1934, for Shafting and Stock Keys. If two or three keys are used, they shall be placed 120° apart.

6-23. GEAR CASES, GUARDS, AND COVERS. - All gears excepting the drum gears and pinions, shall be enclosed in oil tight cases provided with felt seals, oil level gauges or plugs, and drain plugs, and so arranged that one-half of the case may be easily removed for complete inspection of the gears. Access hand holes with tight cover plates shall be provided. Gear cases may be made of cast iron, steel castings, or 3/16 inch minimum thickness steel plate, riveted or welded.

Wheel guards for the gantry truck shall be steel castings or steel plate not less than 3/8 inch thick. Guards for drum gears and pinions shall be not less than 1/4 inch thick.

Suitable drip pans made of steel plate not less than 3/16 inch thick shall be provided to collect oil and grease which may drop from operating parts. All gear cases and drip pans shall be provided with means for cleaning and draining without dismantling any of the equipment.

6-24. LUBRICATION. - The lubrication of the mechanical parts of each crane shall be by means of high pressure grease, except that lubrication of the motors and speed reducers shall be as provided by the manufacturer of these units, and that packed type journal boxes for the gantry and trolley trucks shall be provided with Stapax journal lubrication or equivalent. All high-pressure grease-lubricated points shall be provided with industrial type button-head fittings which shall be located in readily accessible positions. If necessary, the fittings shall be connected with the points of lubrication by tubing which shall be of copper or brass, of ample size and strength to withstand the cold lubricant working pressure, and securely fastened.

6-25. TOOLS AND INSTRUCTIONS. - On each crane, a complete set of high-grade wrenches and other necessary tools shall be provided in sufficient variety to turn every size bolt, nut, and screw on the crane and including any special tools necessary to reach difficult positions. Each tool shall be stamped or provided with a metal tag so that it may be easily identified as to its use and size. Suitable metal racks shall be provided in the operator's cab with a designated place for each tool and with space for grease gun and oil can. A metal rack for a complete set of spare fuses and light bulbs shall also be installed in the cab. The tool rack and the fuse rack shall each be mounted in a substantial metal case with hinged door and catch. One grease gun, one oil can, one set of spare fuses and one set of spare light bulbs shall be furnished.

A complete set of instructions covering the care and operation of the crane shall be provided for reference. In addition, a printed copy or black line print of general operating instructions, mounted in a metal frame fitted with a glass cover, shall be installed in the operator's cab.

6-26. NAME PLATES. - The contractor may furnish and attach to each crane structure one name plate measuring not more than 12 inches by 18 inches stating the rated capacity of the main hoist and the auxiliary hoise and the contractor's name.

## SECTION VII - ELECTRICAL EQUIPMENT

7-01. GENERAL. - All electrical equipment and wiring on the cranes shall conform to the requirements of the National Electrical Code, the National Electric Safety Code, and the Standards of the National Electric Manufacturers' Association, except as otherwise specified herein. All safety devices such as mats, railings, screens, guards, or equipment required to meet these codes and standards shall be furnished by the contractor. All equipment and devices necessary for proper operation of the cranes in the manner specified, whether or not particularly called for, shall be furnished by the contractor.

The power supply will be at 440 volts, 3 phase, 60 cycles, and will be taken to the crane collectors through main copper conductors furnished by the Government and located in a recess in the upstream side of the dam below the level of the deck.

ll safety switches, drum switches, magnetic switches, main line contactors and main wiring shall be furnished with sufficient machanical thermal, and short-time current capacity to be fully protected by the main fuses under short circuits of any value up to 10,000 RMS amperes.

7-02. MAIN CONDUCTORS ON DAM. - The main conductors in the slot on the upstream side of the spillway bridge and east bulkhead, together with steel supports; connection and covers, will be furnished by the Government.

7-03. COLLECTORS AND CONDUCTORS ON CRANE. - The contractor shall furnish, for the main power take-off, bronze shoe collectors installed on the steel collector arm (paragraph 4-07) and designed to operate on the curved main conductors. The shoe collectors shall be Electric Service Supplies Company, Type DM, or equivalent, with porcelain or composition insulators rated not less than 1000 volts.

The contractor shall provide approved insulated flexible power and control cables looped from a terminal box, attached to the roof structure of the trolley housing, to a terminal box on the crane trolley. The total trolley travel will be approximately 22 feet. The cable installation shall provide secure anchorage and support, as well as maximum protection against abrasion and other mechanical injury. The cables shall be made of extra flexible individual conductors insulated as specified in paragraph 7-13, and in addition each cable assembly shall have a 60 percent tough rubber jacket.

7-04. MAIN SUPPLY SWITCH. - A three-pole, single-throw, bottom-fused, 400 ampere, 575-volt, enclosed safety switch with 400 ampere non-renewable fuses shall be provided in the supply circuit. The switch shall be conveniently located near the cab entrance. A 25 watt pilot lamp and resistor connected to the supply side of the main switch shall be provided and installed on the switch enclosure.

7-05. MAIN SUPPLY CONTACTOR. - A 300 ampere, 575-volt, enclosed type, 3 pole main contactor shall be provided and connected so that it will be tripped instantaneously by overload on any main motor circuit and by all emergency circuits and protective devices. The circuit also shall be connected so that all drum controllers must be in the "off" position before the main contactor can be reclosed. The contactor shall operate within the voltage and temperature limits specified in paragraph 7-07.

A heavy duty "Start-Stop" push button station shall be located conveniently near the operator's stand to provide for emergency trip.

A weatherproof, heavy duty, maintaining contact push button station shall also be provided, within reach from the roadway curb, near each end of the crane. The push button switch shall interrupt the control circuit of the main supply contactor to provide emergency shut-down of the entire crane.

7-06. CONTROLS. - The master switches and control panels shall be located in the operator's cab and arranged so that one operator may control all functions of the crane with maximum convenience and visibility. Interlocks shall be provided to limit operation to only one motion at a time.

The controls for the main hoist, auxiliary hoist, and gantry drive motors shall be of the full magnetic, reversing, time-limiting acceleration type, operated by master switches with vertical handles. The gantry travel motors control shall be so connected that all four motors must operate together and shall have a drift point for both directions of travel for operating a thrustor motor brake circuit magnetic contactor. The control for the trolley travel motor shall be of the semi-magnetic, reversing type operated by a drum switch with a vertical handle. The reversing may be done by means of contactors in the controller itself.

Each drum and master switch shall be provided with a vertical handle and deadman pilot contact control or spring return. All motor controls shall have not less than five accelerating points and shall limit the operation of the motor to that accelerating point corresponding to the position of the master switch. Each drum and master switch shall be enclosed in dust-tight cases and shall be provided with conduit entrance boxes. The bearings shall be of the removable bushing or ball-bearing type. The drum contact fingers shall be self-aligning and adjustable to compensate for wear and shall be easily renewable. Terminals for clamp-type solderless connections shall be provided for all leads and shall have identifying markers.

The magnetic contactors for each motor shall be mounted on a moulded ebony asbestos panel not less than 1½ inches thick and each panel shall be mounted in a totally enclosed ventilated steel cabinet provided with removable panels in the rear and hinged doors with three point vault type latches and handles in the front.

A two-element instantaneous overload relay shall be provided for each motor. Each relay shall be adjustable over a range of 150 to 300 percent of the normal full load rating of the connected motor. Operation of the motor relay shall trip the main line contactor.

Secondary controls shall be rated at least equal to the highest voltage obtained at the slip-rings of the motors under plugging conditions specified in paragraph 7-09.

A three-pole, single-throw, 200 ampere, 575 volt, unfused knife switch shall be provided for each hoist and gantry travel motor branch circuit, ahead of the overload relays and primary contactors. A three-pole, single-throw, 100 ampere, 575 volt, bottom fused knife switch shall be provided in the trolley travel motor circuit ahead of the overload relays and primary contactors.

A two-pole, 60 ampere, 575 volt knife switch with 30 ampere fuse clip and non-renewable fuses shall be provided for each motor control circuit and shall be connected on the supply side of the three-pole motor knife switch in such a manner that all motor control contactors can be operated from the drum controllers without supplying power to the motors.

7-07. MAGNETIC SWITCHES. - Each magnetic switch shall have an enclosed capacity not less than 100 percent of the full rating of its connected motor or load, but in no case less than 75 amperes, with temperature rise of contacts not to exceed 65 degrees centigrade above 40 degrees centigrade ambient air outside the enclosing case. Each switch shall be designed for full voltage line start motor control and shall be provided with arc suppressors. All operating coils shall operate successfully on any voltage from 85 to 110 percent of normal, and the maximum temperature rise shall not exceed 65 degrees centigrade measured by thermometer above an ambient temperature of 40 degrees centigrade outside the enclosing case. Each switch shall be enclosed in a safety type steel enclosure or mounted on a control panel which shall be enclosed as specified in paragraph 7-06.

7-08. LIMIT SWITCHES. - Limit switches shall be provided to control the upper limits of travel of the main hoist and of the auxiliary hoist. The trolley travel and the gantry travel shall be controlled in both directions by limit switches. Trippers for operating the gantry travel limit switch shall be furnished by the contractor for installation by the Government near each end of the runway.

Limit switches shall be connected in pilot circuits only. The making and breaking of the contactor operating coil currents shall be done by suitable relays of ample capacity. They shall be of the outdoor, weatherproof type and shall be provided with conduit connections. All limit switches shall reset automatically.

7-09. MOTORS. - All motors shall be rated 440 volt, 3 phase, 60 cycles, with torque and capacity as required for the duty specified and with frame type time and temperature ratings, and speeds as follows:

| Motor | Frame Type | Time & Temp. Rating | Synchronous Speed not to exceed |
|---|---|---|---|
| Main Hoist -------------- | Open | 60 minute | |
| | Wound Rotor | 50° C. | 600 |
| Auxiliary Hoist --------- | Open | 60 minute | 900 |
| | Wound Rotor | 50° C. | |
| Trolley Drive ----------- | Open | 30 minute | 900 |
| | Wound Rotor | 50° C. | |
| Gantry Travel ----------- | Open | 60 minute | 1800 |
| | Wound Rotor | 50° C. | |
| | Gearmotors | | |

Commercial test shall be made on all motors in accordance with NEMA Code MG9-541. Four copies of each test shall be submitted to the contracting officer for approval. Each motor shall have ball or roller bearings dust-proof housings having adequate means of retaining the correct amount of lubricant without dripping. Windings shall be insulated with AIEF Class "A" insulation, especially impregnated to withstand moisture and braced to withstand starting, running, and plugging stresses. All motors shall withstand 50 percent overspeed and plugging at 100 percent speed without mechanical injury and without the secondary voltage exceeding the rated voltage of the secondary controls. The starting torque of all motors shall be not less than 200 percent of full load torque at rated voltage with the rotor in the angular position for minimum torque and with secondary resistance of value for maximum torque. Each slip ring shall have at least two brushes with flexible copper shunts.

7-10. POWER FACTOR CORRECTION. - Static capacitors shall be provided for power factor correction of the main hoist motor and the gantry travel motors. The capacities shall be connected directly to the motors so that no additional control or protective equipment will be required. Capacitors shall be rated in kva at not less than fifty percent (50%) of the horsepower rating of the motors to which they are connected. Capacitors shall be similar and equal to Type FP, manufactured by Westinghouse Electric & Manufacturing Company.

7-11. ELECTRIC BRAKES. - All motors shall be provided with shoe type brakes of rugged construction and positive action. They shall be so arranged that they may be released manually, but cannot be locked in the released position. The main hoist shall be equipped with thruster brakes, floor mounted, with the rating at each drum 100% of the rated motor torque. The auxiliary hoist motor and each gantry travel motor shall have floor mounted thrustor brakes, each rated at 150% of the rated motor torque. The trolley drive motor shall have a motor mounted thrustor or solenoid brake rated at 150% of the rated motor torque.

All brakes shall have non-corrodible operating mechanism wearing parts, shall be self-aligning, and shall have independent adjustment for lining wear and torque. Thrustor windings and solenoid coils shall have special moisture-resisting Class A insulation. The temperature rise of the brake solenoid coils shall not exceed 65 degrees C. by thermometer and the temperature rise of the thrustor motors shall not exceed 55 degrees C. above 40 degrees C. ambient air under continuous service. The brakes on the gantry travel motors shall be designed for quick release, and for gradual application which shall be adjustable over a period of one to twenty seconds inclusive. All other brakes shall be designed both for quick release and quick setting without undue shock or impact.

7-12. RESISTORS. - Resistors shall be of non-corrodible resistor metal strap having negligible temperature coefficient of expansion, edgewise wound about an insulating support. The resistor design for the various motors shall conform to suitable NEMA classifications for continuous duty, and shall be of sections suitable for five accelerating points. Barriers of compressed asbestos fibre composition shall be provided between motor starter resistor assemblies. All resistor assemblies shall be mounted in a suitable, enclosed, weatherproof, ventilated space, preferably above the operator's cab.

7-13. INSULATED CONDUCTORS, WIRING AND CONDUIT. - All wiring shall be furnished, and installed as far as practicable, by the contractor. All wiring except flexible cables shall be installed in rigid threaded, galvanized steel conduit with watertight junction and pull boxes at intervals close enough to allow the cables or wires to be pulled without abrasion or injury. Conduit shall conform to Federal Specifications WW-C-581-A with both inside and outside surfaces and all threads zinccoated. The conduit shall form a continuous watertight system, rigidly supported. Where conductors connect to the current collectors or trolley conductors, conduit fittings with gasket shall be installed with necessary drip loops. The entire conduit system shall be grounded and drained. No conduit shall be smaller than 3/4 inch size.

The wire for the service between the main collectors and the main switch shall be stranded copper and not less than 4/0 AWG. All wiring except that adjacent to resistors and except control panel wiring shall be stranded copper, insulated in accordance with Federal Specification JC-106a. All panel wiring shall be minimum No. 12 AWG, tinned, solid, and equal to Rockbestos Products Corporation 600 volt Rockbestos switchboard wire. All wire adjacent to resistors shall be stranded, equal to Rockbestos 600 volt rheostat wire.

7-14. **SANDERS**. - One electromagnetic sander shall be provided for each gantry truck of each crane. The sander hoppers shall be approximately two-cubic foot capacity. Each shall be equipped with a solenoid-operated brass sand valve and a totally enclosed watertight heating element suitable for continuous service. The sanding pipes shall be arranged to deliver sand as near as possible to contact point between the crane rail and truck wheels for both directions of travel.

A 60ampere, 575 volt, 2-pole, fused safety switch shall be mounted in the operator's cab and connected to the 400 volt main bus to supply service to the sander heating elements. The solenoid values shall be controlled by a 600 volt foot switch on the cab floor. Sanders as manufactured by the Nichols-Lintern Company, or equal, will be acceptable.

7-15. LIGHTING. - A weatherproof lighting installation shall be provided to illuminate the area in front of the operator's cab, gate slot, and a portion of the runway at each end of the gantry cranes as indicated on the drawing. The lighting units shall be of the types shown on the drawing and in addition thereto, an adequate number of suitable lighting units shall be provided in the operator's cab and in the trolley housing. 110-volt plug receptacles shall be provided as indicated on the drawings. The lights and plug receptacles shall be energized by a 440-220/110 volt, dry-type, two-winding transformer of adequate capacity mounted on the crane and fed from the 3-phase power supply. The 444-volt branch circuit for the lighting system shall be protected by a suitable circuit breaker. A 115/230 volt panel board shall be provided in the operator's cab and shall contain at least 2 square single-pole circuit breakers in addition to those required for protecting and controlling the branch circuits to lights and plug receptacles.

7-16. WARNING SIGNAL. - Each crane shall be provided with one double-headed, motor driven, vibratory type, 110-volt, single-phase weatherproof, heavy-duty siren, as manufactured by the Electric Service Supplies Company, or equal, so mounted as to signal to both directions of travel. A foot-operated switch shall be provided in the operator's cab for operating the siren.

7-17. NAME PLATES AND MARKERS. - Each push botton, control switch, circuit breaker, magnetic switch, drum controller, knife switch, and motor protective relay shall be provided with an approved name plate, containing an inscription which shall give the circuit and the function of the device. Suitable markers shall be provided for all resistors, conduits and wiring. These markers may be suitable tagged or name plates securely fastened to the device.

7-18. GASOLINE-ELECTRIS GENERATING UNIT. - Crane No. 1

(a) General. - The gasoline-electric generating unit shall be provided on Crane No. 1 only and shall consist of a gasoline engine of not less than 6 cylinders direct connected through a flexible coupling to a 156 kva. 80% power factor, alternating current generator mounted on a cork insulated common base. The contractor shall furnish the accessories listed in paragraph 7-18(b)(15), and all other parts, fittings or accessories necessary for the complete installation, including switchboard and electric wiring from the generator.

(b) Gasoline Engine.

(1) The engine shall be of the 4-cycle internal combustion type, and shall be capable of developing not less than 200 brake HP for continuous operation at 1800 R.P.M., operating on gasoline conforming with Federal Specification VV-G-101a, "Gasoline, Motor, U. S. Government".

(2) Governor. - The engine shall be equipped with a suitable governor. The normal full load speed of the engine shall be 1800 R.P.M. and the normal no load speed shall not exceed 1890 R.P.M. The speed of the engine may vary between 1800 R.P.M. and 1890 R.P.M., in proportion to the percentage of loading, but for any constant loading between no load and full load, the speed shall not fluctuate more than 1½%, from the normal speed for such percentage of loading. When the engine is running with no load and full load is suddenly applied, the speed shall not fall more than 6% below full load speed and shall return to normal full load speed within 6 seconds. When the engine is running under full load and the load is suddenly thrown off the speed shall not increase more than 6% above the normal no load speed and shall return to the normal no load speed within 6 seconds.

(3) Cylinders. - The cylinders shall be case from hard close grained gray iron or of nickel alloy iron. The cylinders may be cast enblock or in pairs, but shall not cast itegral with the crank case. If cast in pairs they shall be provided with removable wet sleeve liners. They shall have water jackets of ample size to insure thorough circulation and uniform cooling.

(4) Cylinder Heads. - Cylinder heads shall be removable, completely water jacketed and preferably of the same material from which the cylinders are made. They shall be secured to the cylinders with a sufficient number and size of studs to insure freedom from gasket leakage.

(5) Piston and Pins. - The pistons shall be a suitable lightweight alloy. The piston pins shall be provided with liberally proportioned bearings.

(6) Connecting Rods. - The connecting rods shall be forged from high-grade material, heat treated. The crank pin end of the rods shall be machined and fitted with renewable, bronze or steel backed, babbit-lined bearings.

(7) Crankshaft. - The crankshaft shall be drop forged from a suitable high-grade steel and heat treated. The crankshaft and reciprocating parts shall be cynamically balanced for the normal speed range of 1800 to 1890 R.P.M. and there shall be no injurious vibrations at any operating speed up to 40% above normal no load speed.

(8) Camshaft. - The camshaft shall be drop forged with cams forged integral and all cams and bearings ground to size. The camshaft may be driven by an arrangement of gears or may be chain driven. The proportions of parts and materials used in the camshaft drive system shall be such as to insure long life and quiet trouble-free operation. Adequate provisions shall be made for lubrication of all parts.

(9) Main Bearings. - The number of main bearings shall not be less than four. The bearings shall be so designed and placed that they may be replaced without difficulty. The main bearings shall be fitted with renewable bronze or steel backed, babbitt-lined bearings or other equally suitable metal.

(10) Crank Case. - The crank case shall be made of suitable material and of sufficiently rigid construction to hold all cylinders, bearings, and other working parts in proper alignment. They shall be provided with inspection plates so arranged as to give easy access to the interior of the crank case for inspection and the adjustment of connecting rods and other parts.

The crank case shall be so arranged as to present a neat appearances and shall be mounted upon a suitable sub-base or bed-plate common to both engine and generator.

(11) Valves. - The valves shall be of a material that will withstand high temperatures without warping or pitting. They shall be so proportioned for area and lift as to insure low velocities for entry and exit of gas and quietness in operation.

(12) Lubrication. - The engine shall be provided with a suitably arranged oil pump which shall deliver lubricating oil under pressure to the main bearings, crank pin bearings and camshaft bearing and, if the engine is of overhead valve type, to the valve rocker arms. Pressure lubrication of piston pins, timing gears, cams and valve tappets will not be required if other means which will insure ample lubrication are provided.

(13) Cooling System. - The engine shall be provided with a radiator of high-grade construction and material, and of sufficient cooling capacity to keep the cooling water below the boiling temperature under continuous full load operating conditions, when the ambient temperature is 100 degrees F. A suitable fan, driven by the engine, shall be provided for circulation of air through the radiator. The radiator shall be provided with a suitable sheet metal hood to exhaust the air.

(14) Ignition System. - The engine shall be provided with dual ignition. One system shall operate from the storage battery and shall consist of breaker, distributor, coil and high-tension wiring to a spark plug in each cylinder; the other system shall consist of a suitable magneto with impulse starter couplings, breaker points and distributor and shall have high tension wiring and spark plugs entirely independent of the battery ignition system. The magneto shall be driven through an impulse coupling and the engine provided with suitable means for hand starting or magneto ignition in case of the failure of batteries.

(15) Engine Accessories. - The following accessories shall be furnished by the manufacturer of the engine:

1. Electric Starter
2. Electric generator for starter equipment
3. 12-volt heavy duty type battery, in black steel japanned or enameled case, lead lined on the inside and mounted in or attached to the base
4. Oil cooler and filter
5. Air cleaner and fire screen
6. Water Circulating pump
7. Engine driven fuel pump
8. All special tools and wrenches
9. Instrument board, mounted on the engine and containing an oil pressure gauge, ammeter, selector ignition switch, start switch and tachometer
10. Flexible coupling similar or equal to the "Fast" type, with suitable guard, for connecting engine to the generator
11. Overspeed ignition cut-out switch
12. Water temperature thermometer

(16) Miscellaneous Parts. - The contractor shall furnish the following items for the unit and such other parts necessary to complete the installations:

1. Hand operated gasoline pump to supply fuel tank
2. 60-gallon capacity fuel tank
3. Dry exhaust muffler, Maxim, Burgess or Equal
4. Complete fuel and air vent system

5. Flexible metal exhaust hose fitted with brazed metal, connections and flanged to fit engine exhaust manifold.

(17) Spare Parts. - The contractor shall furnish the following spare parts:

1 only piston, complete with rings, connecting rod and wrist pin with shims and bolts.
1 only cylinder head.
2 only cylinder head gaskets.
1 only complete set of exhaust and intake valves, with springs and other pertinent parts.
1 only complete engine water circulating pump.
1 only complete set of spark plugs.
1 only main bearing shell for each size and type used.
1 pair crankpin bearing shells.

The parts shall be suitably packed to prevent corrosion and the packages properly marked for identification.

(c) Generator, Exciter and Voltage Regulator.

(1) General. - The generator and exciter windings for each unit shall be insulated with class "A" insulation and thoroughly impregnated with "moisture and oil resistant" insulating compound and baked. Brushes shall be of ample size and brush holders sturdy in construction. Ferrous accessory parts of generator and exciter including bolts, screws and brush holders shall be "Parkerized" or treated in a similar manner acceptable to the contracting officer. Details of construction shall be such as to provide satisfactory service under long periods of idleness in a damp atmosphere. Antifriction bearings of ample size inclosed in dust-proof housings shall be provided. The generator shall be connected to the engine by means of a flexible coupling. A suitable exciter field rheostat arranged for mounting off the rear of the switchboard and for operation by a hand-wheel from the front of the switchboard shall be provided. The overall diameter of the rheostats including the mounting holes shall not exceed 15 inches. The generator and exciter, unless otherwise required by these specifications, shall conform to the current rules, regulations and standards of the "National Electrical Manufactures Association" and the "American Institute of Electrical Engineers". All parts of the generator and exciter shall be easily accessible for inspection, repair and replacement. Provision shall be made for feeding power from the generator, through the collectors into the collector bus, for use on the other crane or other equipment.

(2) Generator. - The generator shall be of the revolving field, synchronous type with direct-connected exciter and shall be of standard construction with drip-proof covers. The generator shall have a capacity of 156 kva, with 80% lagging power factor, 50 degrees C. continuous duty, 1800 R.P.M., 3 phase, 60 cycle, 480 volts. The stator leads shall be of extra flexible standard cable and provided with terminal lugs housed in a terminal box with a removable cover. Terminal lugs shall be provided at the rotor brush holders for making the necessary field connections, and a suitable terminal clamp or box shall be mounted for supporting the field leads. Frame and end brackets shall be of refined cast iron, the feet being cast integral with the frame or of equally sturdy construction. Amortisseur windings shall be provided and shall be of copper bars driven through slots in the pole faces and welded to common end rings. The end rings shall consist of sections corresponding to the pole pieces. The ring sections shall be securely bolted together where they adjoin. Collector rings shall be of bronze or brass securely mounted and adequately insulated from the shaft in accordance with

approved construction methods. They shall be smooth and assembled concentric with the shaft on which they are mounted. The voltage regulation of the generator at 80% power factor lagging shall not exceed 30 percent. The full load efficiency of the generator, not including rheostat or exciter losses, shall not be less than 85% at 80% power factor lagging.

(3) Exciter. - The exciter characteristics shall be such as to provide good regulation of the generator up to 150% of rated load at 80% lagging power factor and shall be designed for operation with an automatic voltage regulator. The terminal voltage shall be 125 volts, D.C. It shall be supported on the generator end bracket, and the armature sleeved on the generator shaft. The frame shall be of drip-proof-construction. Satisfactory commutation shall be obtained throughout the load range required by the generator without adjustment of brushes. The commutator shall be smooth, true and concentric about its shaft. Brushes shall not chatter or stick in holders. The leads from the exciter shall be inclosed in a terminal box mounted on the exciter frame with each lead properly identified.

(4) Automatic Voltage Regulator. - The contractor shall furnish an automatic voltage regulator to be used in connection with the operation of the unit. The voltage regulator shall be mounted on the switchboard. The automatic voltage regulator shall be similar and equal to General Electric Company type GDA or Westinghouse Electric and Manufacturing Co. "Silverstat" regulator and shall be of suitable design for satisfactory operation with the generator and its exciter. The sensitivity of the regulator shall be within plus or minus two percent at normal voltage and 80% power factor. The regulator shall include the furnishing of all necessary auxiliary equipment such as condensers, external resistors and potential transformer.

(5) Tests. - The generator and exciter shall be assembled at the manufacturer's plant and the following tests made on the generator in the presence of a duly authorized representative of the contracting officer.

a. Resistance of stator and field windings.
b. Polarity of all field poles.
c. Efficiency at 1/2, 3/4 and full load; all at 80% power factor.
d. Regulation at rated load.
e. Heat run.
f. Dielectric test.

Three certified copies of the above test data shall be supplied to the contracting officer. Three certified copies of tests on the exciter in accordance with paragraph MG9-55 of "N.E. M.A., Motor and Generator Standards" Publication No. 38-49, May, 1938, shall be submitted to the contracting officer. Above tests shall be made in accordance with the latest standardization rules of the American Institute of Electrical Engineers.

(6) Spare Parts. - A square set of generator and exciter brushes shall be furnished.

(d) Battery Charger. - A battery charger suitable for operation on a nominal 115 volt, 60 cycle, A.C. circuit and with a capacity of 6 amperes D.C. shall be provided. The D.C. voltage shall be adjustable from 6 volts to 45 volts. The battery charger shall be equipped with a D.C. output ammeter, a switch and a fuse to protect it against overloads and short circuits. The battery charger shall be designed so that the battery will not discharge in case of A.C. voltage failure and the charger will resume normal operation when line voltage is restored. It shall have a tapering charging rate and be inclosed in a wall mounted steel cabinet with hinged door. The finish shall be rust-resisting and durable. The polarity of the D.C. leads or terminals shall be plainly marked.

(e) Bed Plate. - The bed plate for the unit shall be designed by the contractor and shall be intergral for engine and generator. The sub-base or bed plate shall be of rigid construction and may be either an iron or steel casting or it may be fabricated by welding of structural steel plates and shapes. It shall be the responsibility of the contractor to furnish a design which will not result in excessive vibration of the unit and the bed plate shall rest on "Vibracork" or equal, or on suitable springs, If cork is used the bed plate shall be provided with drip-proofedges and suitable arrangement for retaining the cork in proper position. A design of sub-base of unsightly appearance or which would be, in the opinion of the contracting officer, otherwise unsuitable will not be accepted. The cork furnished under this contract shall be 2" thick and shall be Armstrong Cork and Insulation Company's "Vibracork", light density, or approved equal. This reference given is for descriptive purposes only. Structural steel angles, suitable in size and form to fit around the bed plate and secured to the floor, shall be provided for retaining the cork insulation.

(f) Shop Inspection and Tests. - The unit shall be assembled in the contractor's shop for shop inspection and the following tests shall be made under the conditions specified in sub-paragraph 7-18(b)(2). The tests shall be made in the presence of a representative of the contracting officer. All tests shall be made at the expense of the contractor except the expense of the Government Inspector.

(1) The engine only shall be run for two (2) hours at full rated H.P. on dynamometer test.

(2) The combined unit shall be run continuously for twenty-four (24) hours at full load or as directed.

(3) The carburetor butterfly valve setting and governor control shall be carefully checked with the entire unit operating under various load conditions ranging from no load to 115% of the generator rating. During these tests the following shall be recorded:

R.P.M. - load-exhaust temperature-circulating water temperature-lubricating oil temperature-fuel consumption, and such other data as may be required by the contracting officer or his representative. Typewritten records of all the above tests, including all observations, calculations, results and graphs, all certified, shall be submitted in triplicate by the contractor to the contracting officer as soon as practicable after completion of the tests. Final test and trials will be made after installation and will be of sufficient duration to demonstrate to the satisfaction of the contracting officer that the units are in conformity with the specifications. The tests shall be run with gasoline conforming to Federal Specifications VV-G-101a for "Gasoline; Motor, U. S. Government".

(g) Tests After Alteration. - In the event that the unit does not meet all the requirements of these specifications, the contractor shall make such alterations and replacements as may be necessary to insure that the performance of the unit meets the requirements. The expense of additional tests, if required shall be borne by the contractor.

7-19. OPERATOR'S CAB HEATERS. - Built-in electric heaters shall be provided in the operator's cab. They shall have variable control for three-heat operation and shall be capable of maintaining a temperature differential of 100 degrees F. over the outside air when operating at full load with the cab insulated as required by paragraph 4-06.

## SECTION VIII - MATERIALS

### 8-01. GENERAL.

(a) Materials. - All materials shall be of new, unused stock and free from defects. Materials indicated on the drawings or required in the work and not covered elsewhere in these specifications by detailed requirements shall conform to the requirements of this section. Any materials required which are not covered by detailed specifications herein or elsewhere in the specification shall conform to the applicable Federal Specifications, grade and/or class as required or, in case there are no applicable Federal Specifications, to applicable specifications of the American Society for Testing Materials (A.S.T.M.). In all other cases not specifically covered herein the contractor shall furnish the highest grade commercial material or product.

(b) Shop Inspection and Material Orders. - Material and equipment ordered by the contractor for this work shall not be shipped from its point of manufacture before it has been inspected, unless the contracting officer authorizes the inspection to be made elsewhere. The contractor shall furnish to the contracting officer a list of sub-contractors and vendors with whom orders are to be placed for materials or equipment which will enter directly into the work of this contract; and, also, triplicate copies of mill and shop orders as they are issued. Copies of orders shall be issued far enough in advance of the beginning of operations to permit the making of arrangements for inspection. Mill and shop orders shall bear notations showing that the material is subject to Government inspection, the specification designation under which the material ordered is to be furnished, and the drawing and part number, if any, pertinent thereto. The contracting officer may accept certified copies of test reports in lieu of inspection at the point of manufacture.

Except as otherwise provided, the inspection and testing of metals shall be carried out in accordance with the requirements of Federal Specification QQ-M-151a.

(c) Tests. - The contractor shall at his expense, in all cases except upon specific waiver by the contracting officer, prepare specimens and perform tests and analyses as required to demonstrate conformance of the various materials with the pertinent specifications, and shall furnish to the contracting officer certified test reports in triplicate. He shall also furnish to the contracting officer test pieces and samples for independent analysis and test if requested.

(d) Federal Specifications. - Copies of Federal Specifications referred to herein may be procured from the Superintendent of Documents, Government Printing Office, Washington, D.C., at a price of five or ten cents each. When the term, "Federal Specifications" or "A.S.T.M. Specifications" is used, the reference shall be construed to mean the cited specification as modified by any amendments made before the date of opening bids for the contract.

8-02. STRUCTURAL CARBON STEEL. - Structural carbon steel shall conform to Federal Specification QQ-S-711a for "Steel, Structural; (for) Bridges", Class A. Surface imperfections shall be remedied by arc-welding and according to Government practice. The chemical properties of the steel shall be such as to permit it to be readily welded by this process.

8-03. COPPER-BEARING STEEL SHEETS AND PLATES. - Copper-bearing steel sheets and plates shall conform to Federal Specification QQ-S-711a for "Steel, Structural; (for) Bridges" Class B.

8-04. RIVET STEEL. - Rivet steel shall conform to Federal Specification QQ-S-711a for "Steel, Structural; (for) Bridges", Class C.

8-05. STEEL RAILS. - The rails for the trolley runway shall be Lorain Section 175-418. They shall be new and shall conform to the Standard Specification of the A.S.T.M. for "Open Hearth Steel Girder Rails of Plain, Grooved and Guard Types", Designation A 2-27 for Class A, No. 1 rails except that the lengths of all rails shall be in accordance with the design drawings. The rails shall be heat-treated uniformly throughout their entire length and cross-section to above the critical temperature, quenched and tempered to produce a Brinell hardness of 320 to 350. Heating, quenching and tempering shall be done with equipment which will accommodate the entire length of each piece. After heat-treatment the rails shall be smooth on the head, straight in line and surface and without any twists, waves, or kinks.

8-06. CARBON-STEEL FORGINGS. - Carbon-steel forgings shall conform to the Tentative Specification of A.S.T.M. for "Carbon-Steel Forgings for General Industrial Use", Designation A 235-40T.

8-07. ALLOY-STEEL FORGINGS. - Alloy-steel forgings shall conform to the Tentative Specifications of the A.S.T.M. for "Alloy-Steel forgings for General Industrial Use", Designation A 237-40T, Class E.

8-08. HOT ROLLED STEEL - Hot rolled steel shall conform to the Standard Specification of the A.S.T.M. for "Commercial Quality Hot-Rolled Bar Steels", Designation A 107-40, Grades 3, 5, 6, or 7.

8-09. COLD-FINISHED STEEL. - Cold rolled steel shall conform to the Standard Specification of the A.S.T.M. for "Commercial Cold-Finished Bar Steels and Cold-Finished Shafting", Designation A 108-36, Grades 1 to 10.

8-10. BOLT AND NUT MATERIAL.

(a) Unless otherwise specified or called for on the drawings, the material for bolts and nuts shall conform to the Standard Specification of the A.S.T.M. for "Commercial Quality Hot Rolled Bar Steels", Designation A 107-40, Grades 22, 23, 24, or 25.

(b) The material for bronze bolts and nuts shall conform to Federal Specification QQ-B-636 for "Brass, Naval; Bars, Plates, Rods, Shapes, Sheets, and Strips", Type I, half hard.

(c) The material for bolts and nuts of "high strength steel" shall conform to the Tentative Specification of the A.S.T.M. for "Alloy-Steel Forgings for General Industrial Use", Designation A 237-40T, Class D.

8-11. ROLLED STEEL WHEELS.

(a) The steel for the gantry and trolley wheels shall conform to the Standard Specifications of the A.S.T.M. for "Multiple-Wear Wrought Steel Wheels", Serial Designation A 57-39. The treads of the wheels shall be heat-treated to produce a Brinell hardness of 335 to 375. The plate and hub of the wheels may show no appreciable hardness over the untreated condition, but the heat-treating process shall be such as to avoid the setting-up of internal stresses in the plate of the wheel. The contractor shall furnish the contracting officer with certified copies of charts showing the process for each heat-treatment of wheel material.

(b) The contractor may submit an alternate proposal for wheel material which may be approved by the contracting officer, provided the physical characteristics are comparable to those of the material specified above.

8-12. ROLLED STEEL ROPE SHEAVES. - The material for rolled steel rope sheaves shall conform to the Tentative Specifications of the A.S.T.M. for "Carbon Steel Forgings for Industrial Use", Designation A 235-40T, Class F.

8-13. CARBON STEEL CASTINGS. - Carbon steel castings shall conform to Federal Specification QQ-S-681a, for "Steel; Castings", Class a, except where shown otherwise on the drawings or called for in these specifications.

8-14. ALLOY STEEL CASTINGS. - Alloy steel castings shall conform to the Standard Specification of the A.S.T.M. for "Alloy Steel Castings for Structural Purposes", Designation A 148-36, Class B, Grade 2.

8-15. BAR AND MACHINE STEEL. - Bar and machine steel shall conform to the Standard Specificaions of the A.S.T.M. for "Commercial Quality Hot-Rolled Bar Steels", Designation A 107-40, Grade 3, 5, 6, or 7.

8-16. GRAY IRON CASTINGS. - Gray iron castings shall conform to Federal Specification QQ-I-652 for "Iron, Gray; Castings", Class 35.

8-17. Phosphor Bronze. - Phosphor bronze for bushings, unless otherwise specified, shall conform to Federal Specification QQ-B-691 for "Bronze; Castings", and shall be "Composition 10".

8-18. SELF-LUBRICATING BUSHINGS. - Self-lubricating bushings shall be of the bronze and insert type, Lubrite or equal.

8-19. HIGH TENSILE BRONZE. - High tensile bronze shall conform to the Standard Specification of the A.S.T.M. for "Manganese - Bronze Sand Castings", Designation B 54-39.

8-20. CORROSION-RESISTING STEEL. - Corrosion-resisting steel shall conform to Federal Specification QQ-S-763 for "Steel, Corrosion-Resisting; Bars and Forgings", Grade 6 with sulphur content of 0.18-0.35 percent with phosphorus .04 (max); and shall be free machining and suitable for threading and upsetting.

8-21. WELDING RODS AND DEPOSITED WELD METAL. - Welding Rods shall be of the heavily coated type. Filler metal shall have a corrosion resistance at least equal to that of mild structural steel. The ultimate strength shall not be less than 60,000 lb. per sq. in. and the elongation in two inches not less than 20%.

## SECTION IX - WORKMANSHIP

9-01. GENERAL. - All work shall be performed in a thorough, workman-like manner by workmen skilled in their various trades and shall be equal to the best modern practice in the manufacture and fabrication of materials and apparatus of the types covered by these specifications, notwithstanding any omissions from these specifications or drawings.

9-02. SHOP ASSEMBLY.

(a) The contractor shall assemble in the shop all unit parts, such as the complete trolley, except ropes; all gantry trucks with drive machinery; sheave blocks; and the operator's cab, complete with all controls, panels, and the like. All mechanical equipment shall be operated in the shop, after assembly, except such operations as may be specifically waived by the contracting officer. All field connections for the structural steel framework, mechanical, and electrical equipment shall be checked by shop assembling the component parts.

(b) All assemblies will be checked by the contracting officer. All interferences, errors in dimensions, and inaccurate workmanship discovered during the shop assembly shall be corrected. Before disassembly, each part to be shipped separately shall be matchmarked and identified in conformity with the erection drawings. Such marking shall be so done as to retain its legibility until field erection is completed.

9-03. PREPARATION FOR SHIPMENT.

(a) The contractor shall prepare all materials and articles for shipment in such a manner as to facilitate handling and to protect them from damage, and shall be responsible for and make good any and all damages due to improper preparation or loading for shipment. Boxes or crates shall be marked and shall have a packing list enclosed showing the parts contained therein.

(b) Bearing surfaces of shafting and similar parts shall be covered with burlap or lagging. All electrical apparatus shall be crated or boxed. All pieces weighing more than five tons shall have the approximate weight painted thereon.

9-04. TOLERANCES. - Tolerances, fits, and finish shall conform if explicit specification is lacking, with the best modern shop practice in manufacture of finished products of nature similar to those covered by these specifications. Like parts shall be interchangeable insofar as practicable.

9-05. ACCEPTANCE TESTS.

(a) After the gantry cranes have been erected and placed in operating condition, they will be completely tested by and at the expense (except as noted below) of the Government to determine whether the requirement of these specifications have been fulfilled. All gantry crane operations during these tests will be performed by one or more operators furnished by the Government and under the direction of the contractor's erecting engineer. The services and all expenses of the erecting engineer shall be paid for by the contractor.

(b) Each crane shall perform satisfactorily the following operations:

(1) Raise and lower at the specified speeds and hold in any position a test load of 280 tons with the gantry stationary over a gate opening and the trolley over either gate slot.

(2) Transport on the runway at the specified speed a test load of 145 tons with the trolley in any position within the limits of operation shown.

## SECTION X - PAINTS AND PAINTING

10-01. GENERAL. - All paint, when applied, shall provide a satisfactory film and a smooth even surface, and undercoats shall dry without excessive gloss, suitable for the proper application and adhesion of subsequent coats, as approved by the contracting officer. Where necessary, in the opinion of the contracting officer, to suit the conditions of surface, temperature, and weather existing at the particular time of application, the packaged paint may be thinned by the addition of not more than one pint per gallon mineral spirits immediately prior to application, provided that in no case shall the viscosity of the paint be reduced to a point where the specified maximum coverages will be exceeded.

10-02. SURFACE CLEANING AND PREPARATION.

(a) Cleaning. - All ferrous surfaces to be painted shall be thoroughly cleaned of all loose millscale, rust, dirt, and other foreign substances to base metal by sandblasting, flame cleaning, or any other method approved by the contracting officer.

(b) Protection of Surfaces. - Care shall be taken to adequately protect all machinery parts, threads, and finished surfaces during cleaning and preparation.

10-03. PAINT APPLICATION.

(a) All painting shall be done in a neat, thorough, and workmanlike manner. Except where otherwise specified or specifically directed, all paint coats shall be applied by either brush or spray in such manner as to produce an even coating of uniform thickness completely coating all corners and crevices. All painting shall be done by thoroughly experienced workmen. Care shall be exercised during spraying to hold the nozzle sufficiently close to the surfaces being painted to avoid excessive evaporation of the volatile constituents and loss of material into the air. Paint shall be applied only to surfaces that are thoroughly dry and only under such combination of humidity and temperatures of the atmosphere and surfaces to be painted as will cause evaporation rather than condensation. A practical test is to wipe a damp cloth on the surface to be painted. If the moist streak dried promptly, conditions conducive to evaporation prevail. In no case shall any paint be applied to surfaces upon which there is frost or moisture condensation, or during rainy or misty weather, without suitable protection as approved by the contracting officer. Painting during unfavorable weather conditions shall be carried on under a protective covering. While any painting is being done, the temperature of the surfaces to be painted and of the atmosphere in contact therewith shall be maintained at or above 50 degrees F. All paint when applied shall be approximately (within fifteen degrees of) the same temperature as that of the surface on which it is applied. Where protection is provided for paint furfaces, such protection shall be preserved in place until the paint film has properly dried and removal of the protection is authorized by the contracting officer. Working parts, and hardware and other surfaces not required to be painted shall be cleaned and protected to the satisfaction of the contracting officer.

(b) Coverage. - The surface area covered per gallon of paint specified shall be not greater than 425 square feet per gallon.

10-04. PRIMING COATS.

(a) Unpainted surfaces. - The surfaces of all non-ferrous metal-coated surfaces, machined surfaces, surfaces requiring welding, and surfaces which will be in riveted contact shall not be painted unless otherwise specified. All other ferrous surfaces, unless otherwise specified shall receive one priming coat of Synthetic Red Lead Primer.

(b) Structural Parts shall receive one shop priming coat.

(c) Machinery and Mechanical Equipment (except threads and finished surfaces) shall receive one shop-priming coat.

(d) Exterior Electrical Equipment shall receive one shop-priming coat, except that enclosing cabinets and cases shall be given two shop-priming coats on the inside and one shop-priming coat on the outside. All cast metal surfaces requiring painting shall be smoothly finished with an approved filler prior to the application of paint.

(e) Machined Surfaces shall immediately after final inspection be thoroughly cleaned of all foreign matter and coated with a heavy film of Rust Preventive Compound, U. S. Army Specification 2-84A.

(f) Screw Threads shall be protected by a coating of heavy oil.

## 10-05. PAINTS AND PAINT FORMULAE.

(a) General. - Paints shall have the composition as indicated below or as otherwise approved by the contracting officer. All paints, shall be guaranteed by the manufacturer not to gel, liver or thicken deleteriously or form gas in a closed container within a period of one year from date of manufacture.

(b) Processing of Paints.

(1) Except where otherwise specified or authorized, all paint shall be made by grinding together dry or paste pigments and a liquid vehicle to form a smooth paint that will flow freely and will not settle or react deleteriously in containers.

(2) Grinding shall produce a fineness such that coarse particles and skins will not exceed 1.5 percent (total residue left on No. 325 mesh screen, based on pigment). The grinding shall be done in a roll or pebble mill at temperatures that will not cause polymerization.

(3) Skinning shall be negligible after exposing 6 ounces of paint in a tightly closed 8 ounce glass container to sunlight for a total time of 24 hours.

(4) The resulting paint shall have satisfactory brushing and leveling properties, shall set to touch in not less than one hour nor more than four hours, unless otherwise specified, and shall provide a satisfactory film and a smooth even surface without undue glass, suitable for proper application and adhesion of subsequent paint coats, as approved by the contracting officer. Sufficient suitable driers shall be added to make the paint dry hard within 18 hours.

(5) In view of potential variations resulting from variable processing equipment and technique, the manufacturer may be allowed, where necessary to produce the specified viscosities, to make slight changes in formula proportions, subject to specific approval of the contracting officer.

(c) Synthetic Red Lead Primer, shall be composed of materials conforming, where applicable, to the specified requirements and mixed in the proportions as follows:

| | |
|---|---|
| Red Lead - - - - - - - - - - - - - - - - - - | 16.5% by weight |
| Iron Oxide - - - - - - - - - - - - - - - - - | 38.2% |
| Zinc Yellow- - - - - - - - - - - - - - - - | 5.5% |
| Diatomaceous Silica- - - - - - - - - - - | 6.0% |
| Vehicle (see Par. 10-06) - - - - - - - - | 28.0% |
| Thinner - - - - - - - - - - - - - - - - - | 5.8% |

The paint shall have a consistency of flow of between 25 and 40 seconds through the 0.15 inch diameter orifice of a standard consistency cup when tested in accordance with the procedure specified in paragraph 9 and 10 of A.S.T.M., Specification D 333-37 for "Methods of Testing Nitrocellulose Clear Lacquers and Lacquer Enamels." It shall have satisfactory brushing and leveling properties, shall set to light touch in not less than 2 hours nor more than 5 hours, and shall dry hard for recoating in not more than 18 hours, when tested in accordance with paragraph P-2d of Federal Specification TT-V-81a, entitled "Varnish; Mixing (for) Aluminum Paint." The vehicle shall be a synthetic resin varnish consisting of a phenol formaldehyde resin with the necessary oils and volatile thinners to produce elasticity, waterproofness, adherence, and durability in the finished paint film. It shall meet the detailed requirements of paragraph 10-06.

10-06. PHENOLIC RESIN VARNISH VEHICLE shall conform to the following requirements:

(a) Oil-resin ratio shall be 33 gallons of oil to 100 pounds of resin.

(b) Shall be clear and transparent and entirely free from resin, estergum or other non-phenolic resins. Not less than 50 percent by weight of the vehicle shall consist of non-volatile oil and resin.

(c) The resin content shall be 100 percent para-phenyl phenol-formaldehyde condensate similar and equal to Bakelite BR 254, and shall conform to the current U. S. Navy Department Specification 52R10 entitled "Resin Phenol-Formaldehyde."

(d) The volatile thinner shall contain not more than 80 percent mineral spirits and not less than 20 percent high flash coal tar naphtha or high flash hydrogenated petroleum naphtha and shall be free from toxic hydrocarbons such as benzol.

(e) The oil content shall be a ternary oil mixture composed of 40% linseed, 30% liquid oiticica, and 30% "dehydrated" castor oil.

(f) The flash point shall be not below 30 degrees C. in a closed cup tester.

(g) Shall pass a Kauri Reduction Test of 120 percent, using the method described in paragraph F-2g, Federal Specification TT-V-81, for "varnish; Mixing (for) Aluminum Paint."

(h) Shall show no skinning after 48 hours in a 3/4 filled, tight container.

(i) Flow-out films on tin plate panels dried 72 hours shall withstand immersion in cold water for 96 hours, and in distilled water at 200 degrees F. for 7 hours without showing more than a slight haze which shall disappear within one hour, and shall show no other signs of deterioration. The panel shall be allowed to dry and cool for 15 minutes after removal from hot water and shall then be inspected for signs of failure.

10-07. PIGMENTS.

(a) Carbon Black shall conform to either Federal Specification TT-B-601, entitled "Boneblack; Dry, Paste-in-Japan, Paste-in-Oil" or Federal Specification TT-L71 entitled "Lampblack; Dry, Paste-in-Japan, Paste-in-Oil."

(b) Lead Titanate shall be similar and equal to Titanox "L" as manufactured by the Titanium Pigment Corporation.

(c) Red Lead shall conform to Federal Specification TT-R-191a (97) percent Grade for "Red Lead; Dry and Paste-in-Oil."

(d) Iron Oxide shall contain not less than 98 percent $Fe_2O_3$

and shall not contain any organic coloring matter.

(e) Diatomaceous Silica shall be an approved commercial grade.

(f) Zinc Yellow shall contain not less than 40 percent $CrO_3$. It shall be a basic zinc potassium chromate, soluble in acetic acid, free from lead compounds, and containing no added zinc oxide, and shall be stable or non reactive with the pigments and vehicles specified.

(g) Titanium Dioxide shall be similar and equal to either "Ti-Pure O" as manufactured by Krebs Pigment & Color Corporation or "Titanox NC" as manufactured by the Titanium Pigment Corporation.

## 10-08. THINNERS AND SOLVENTS.

(a) Mineral Spirits shall have the following properties:

| | |
|---|---|
| Gravity | 43-47 degrees Baume |
| Flash Point (Closed cup) | 100 degrees F. Min. |
| Initial Boiling Point | 300-310 degrees F. |
| End Point | 405 degrees F. Max. |
| A.S.T.M. Copper Strip Test | Negative |
| Solvency (Kauri-Butanol) | 41 cc (a) 77 degrees F.Min. |

(b) Dipentine shall have the following properties:

| | Maximum | Minimum |
|---|---|---|
| Specific Gravity at 15.5 degrees C. | 0.854 | 0.845 |
| Refractive Index at 20 degrees C. | 1.477 | 1.472 |
| Unpolymerized Residue (percent ($38N\ H_2SO_4$) | 2.5 | |
| A.S.T.M. Distillation Range: | | |
| 5% Distilling at | 173 degrees C. | |
| 10% Distilling at | 175 degrees C. | |
| 97% Distilling at | 188 degrees C. | |
| Color-Lovibond 500 Amber | 3 | |
| Appearance: Clear and free from suspended matter. | | |

(c) Toluol shall conform to U. S. Navy Department Specification 52T7 entitled "Toluene (Toluol)", except that it shall have a solvency (Kauri-Butanol Method) of not less than 100 cc at 77 degrees F.

(d) Xylol shall conform to A.S.T.M. specification D364-36 for "Industrial Xylene (Xylol) or 'Solvent Naphtha'", except that it shall have a solvency (Kauri-Butanol Method) of not less than 93 cc at 77 degrees F.

(e) Normal Butyl Alcohol (Butanol) shall conform to A.S.T.M. Specification D304-33 for "Butanol (Normal Butyl Alcohol)."

(f) Ethylene Glycol Monoethyl Ether shall conform to A.S.T.M. Specification D331-35 for "Ethylene Glycol Monoethyl Ether."

## 10-09. MISCELLANEOUS MATERIALS.

(a) Oil, Linseed shall conform to Federal Specification JJJ-O-331 for "Oil; Linseed, Boiled", or JJJ-O-336, for "Oil; Linseed, Raw", as specified or required.

(b) Insulating Varnish, U. S. Navy Department Specification 52-V-13b, entitled "Varnish; Insulating, (for) Electrical Purposes".

(c) Creosote Paint for surface treatment of timber shall conform to Federal Specification TT-W-561a, entitled "Wood-Preservative: Creosote (for) Brush and Spray Treatment."

(d) Ortho-Phosphoric Acid ($H_3PO_4$), shall be commercially pure product, in liquid form, containing not less than 75 percent $H_3PO_4$.

(e) Sodium Dichromate. ($Na_2Cr_2O_7 \; 2H_2O$) shall be a commercially pure product in crystalline form containing not less than 85 percent $Na_2Cr_2O_7$.

## 10-10. INSPECTION.

(a) Unless otherwise specifically authorized, inspection of all materials for the paints and chemical rust inhibitor and the manufacture thereof, will be made by a representative of the contracting officer. All samples of materials and of the finished processed products will be tested and analyzed for conformity with the specifications by the Government. The inspector will collect for testing, samples of each of the materials to be used in the manufacturing processes and will then seal the material containers until test results from the samples indicate that the various materials conform to specifications. He will witness the breaking of the seals on the approved material containers and the compounding of the materials for the product being manufactured, will collect samples of the finished product for testing, and will witness the placing, sealing, and labeling of the finished product in containers for shipment. After the finished products have successfully passed the prescribed test, shipment of the sealed containers will be authorized.

(b) In the case of ready-mixed and packaged paints of standard manufacture, other than those specified by tradename, the contractor shall furnish a sample in the standard stock package, together with a certified copy of the complete chemical analysis, for test and approval by the contracting officer.

10-11. PAYMENT for all paint and painting will be included in the contract price for the cranes.

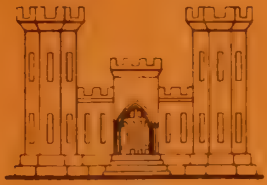
# ST. LAWRENCE RIVER
# PROJECT

## FINAL REPORT

## 1942

DOCUMENTS Room 6

# IROQUOIS DAM
# ANALYSIS OF DESIGN



CORPS OF ENGINEERS, U.S. ARMY

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APPENDIX III-4 (3)

# ST. LAWRENCE RIVER
# PROJECT

* * * * *

# FINAL REPORT
## 1942

# IROQUOIS DAM
## ANALYSIS OF DESIGN

CORPS OF ENGINEERS, U.S. ARMY

U.S. Engineer Office - Massena, New York

July , 1942

APPENDIX III-4 (3)

PART ONE - Iroquois Dam, Analysis of Design.

PART TWO - Point Rockway Canal West of Sta. 159 + 50,
Analysis of Design.

PART THREE - Iroquois Dam and Part of Point Rockway
Canal, Estimate of Cost.

# PART ONE

# IROQUOIS DAM

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# ANALYSIS OF DESIGN

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## SECTION I - INTRODUCTION

1-01. This design analysis presents the general basis of design for the Iroquois Dam, a part of the development of the International Rapids Section of the St. Lawrence River. A considerable number of borings, and other foundation explorations have been completed and the elevation and character of the rock foundation has been determined. The design of all general features of the dam has been determined and contract plans, suitable for the taking of bids, have been prepared. These contract plans will later be supplemented by further detail plans.

Contract plans and specifications are being prepared for the material and equipment which are to be furnished by the Government for erection by the general contractor. The design of that portion of the Point Rockway Canal which is included in the general contract for Iroquois Dam is covered by Part II of this Analysis of Design.

### 1-02. DESCRIPTION OF PROJECT. -

(a) General Description. - The Iroquois Dam will be located on the St. Lawrence River at Iroquois Point, about six miles west of the village of Waddington, New York, and 27 river miles above the Long Sault Dam. The spillway will be a buttressed gravity structure having a maximum height above foundation of 118 feet to the deck. There will be 40 gate openings fifty feet wide extending down to a continuous concrete sill at elevation 200.0, which is approximate river bottom. Piers ten feet thick at the dam axis will form the buttresses and support the deck structure. This spillway section, with an overall length of 2390 feet, will be flanked at each end by a concrete gravity bulkhead 193 feet long. The entire concrete structure, 2776 feet long, will form the arc of a circle having a radius of 1,700 feet at the dam axis. There will be a short earth fill wing dam at each end of the concrete structure. The total length of the dam will be approximately 3,600 feet. The 40 openings between piers will be closed by 32 two-section, fixed-wheel, vertical lift gates and 8 single-section gates of the same type. The latter gates, four at each end of the spillway, rest on concrete stoplogs which will fill the lower halves of these end openings. The gate crests will be at elevation 248. Gate operation will be by means of two traveling gantry cranes. The gate deck will support the gantry tracks, a concrete highway bridge, and will afford room for a possible future railroad bridge.

(b) Purpose. - The Iroquois Dam is intended as flow regulator for the river. It can be used to expedite the formation of a solid ice sheet on the upper river, to dampen seiches due to barometric changes, and to regulate the outflow from Lake Ontario.

### 1-03. PERTINENT DATA.

(a) Approximate Principal Quantities - (Dams and Cofferdams)

| | |
|---|---|
| Excavation, common . . . . . . . . . . | 657,200 cu.yds. |
| Excavation, rock . . . . . . . . . . | 32,000 cu.yds. |
| Concrete, all classes . . . . . . . . . | 243,500 cu.yds. |
| Earth fill for dam . . . . . . . . . . | 205,000 cu.yds. |
| Reinforcing Steel . . . . . . . . . . | 3,000 tons |

| | |
|---|---|
| Structural Steel and Gates . . . . . . . | 15,400 tons |
| Timber for cofferdams . . . . . . . . . | 6,800 MBM |
| Earth fill for cofferdams . . . . . . . | 298,500 cu.yds. |
| Rock fill for cofferdams . . . . . . . . | 106,700 cu.yds. |

(b) Dimensions.

| | |
|---|---|
| Length of spillway (effective) . . . . | 2,000 ft. |
| Length of concrete dam . . . . . . . . | 2,776 ft. |
| Length of Earth Dike - East End . . . | 600 ft. ± |
| Length of Earth Dike – West End . . . | 200 ft. ± |
| Overall Length of Dam . . . . . . . . . | 3,600 ft. |
| Maximum Height of Concrete Dam . . . . | 118 ft. |
| Maximum Width of Concrete Dam . . . . | 83 ft. |

(c) Spillway Control. – Thirty-two 50-foot by 48-foot and eight 50-foot by 24-foot vertical lift, fixed-wheel gates will be operated by means of two 225-ton traveling gantry cranes.

(d) De-icing Provisions. - Service gate guides are to be electrically heated with three 4-watt heating units at each guide or 24 watts per gate. An air-bubbling system is also provided, with 6 vents per gate. Three of these are upstream all near the bottom of the top gate section.

(e) Elevations.

| | |
|---|---|
| Top of Dam (gate Platform) . . . . . | 262.00 |
| Top of Spillway gates . . . . . . . . | 248.00 |
| Gate Sills . . . . . . . . . . . . . . | 200.00 |
| Top of Earth Dikes . . . . . . . . . . | 254.50 |
| Maximum Pool . . . . . . . . . . . . . | 248.00 |
| Normal Operating Pool . . . . . . . . | 242.00 |
| Tailwater Range . . . . . . . . . . . | 229.00 - 248.00 |
| Lowest Foundation Rock . . . . . . . . | 144.00 |

| | |
|---|---|
| (f) Drainage Area. - | 298,000 sq.mi. |

(Note: As this dam lies within the backwater of Long Sault Dam hydraulic conditions are dependent on the latter structure and there will be practically no drop at the Iroquois Dam except when half or more of the gate areas are closed.)

1-04. INVESTIGATIONS.

(a) Foundation explorations sufficient for preliminary design have been completed. Some seismic exploration, probing, field compaction studies, and aggregate studies have also been made. It is expected that these will be completed and that foundation stress studies and hydraulic model tests, if required, will also be made before contracts are let.

1-05. LOCATION. - The dam was located at that point in the channel where observations and hydraulic studies of the characteristics of the stream, after the pool had been formed, indicated that the velocity of flow would not exceed 2.25 feet per second. Studies by the Canadian Authorities had shown that the river surface would form a solid sheet of ice at this or lower velocities. A more economical dam could be built at a point several hundred feet downstream from the chosen location but the channeling necessary to avoid turbulent water just above the downstream location would have raised the total cost to a figure higher than the probable cost as shown.

## SECTION II - DESIGN LOADS

2-01. The following excerpts from a memorandum dated February 14, 1941, as revised by a subsequent memorandum dated April 26, 1941, from Mr. Guy A. Lindsay, define the hydraulic conditions governing the design loading: -

2-02. "UPLIFT. - In the following memorandum the extent of 'uplift' is not dealt with as the results of exploration of foundation conditions are not available and the drainage facilities to be provided in the dams are not known. The maximum uplift pressures possible would however be those resulting from the head and tailwater levels shown."

2-03. "CONDITION NO. 1

(a) It is impossible to visualize full Lake Ontario level ever reaching the Iroquois Point Dam, as sufficient gates will always be open to pass the minimum flow of the river. With Lake Ontario level at elev. 249.00 and a flow of 200,000 cfs. the level above the dam would be elev. 248.00.

(b) Tailwater Elevation. - The above high headwater level would only occur if conditions were such that the tailwater level would have to be restored to natural conditions, in which case the tailwater level would be (See Diagram No. 2215 Document No. 3) - - - Elev. 229.00.

(c) Ice Pressure. - Nil."

2-04. "CONDITION NO. 2

(a) Headwater Elevation. - Maximum monthly mean headwater elevation resulting from application of Regulation of Lake Ontario (Method No.5) and backwater studies described in Doc. No. 4 would occur in May 1870 with a flow of 310,000 cfs., under which conditions headwater level would be elev. 245.00. To allow for future channel enlargement, etc., it would appear that maximum operating headwater level should be taken at elev. 246.00.

(b) Tailwater Elevation. - Under ultimate operating conditions, the loss of head through the dam may be as low as 0.5 feet. Therefore, the tailwater level would be elev. 245.50.

(c) Ice Pressure. - Nil."

2-05. "CONDITION NO. 3

(a) Headwater Elevation. - As in condition No. 2, elev. 246.00.

(b) Tailwater Elevation. - Conditions might arise under which it might be desirable to lower the water level below the dam to natural conditions, in which case the tailwater level, with a flow of 310,000 cfs. would be (See Diagram No. 2215, Document No. 3), elev. 235.00.

(c) Ice Pressure. - Nil."

2-06. "CONDITION NO. 4.

(a) Headwater Elevation. - During the 80 years studied, the water level above the dam on the 1st of January would be above elev. 224.00 nineteen times and above elev. 243.5 forty-four times. Allowing for future channel improvements, etc., the maximum headwater level under these conditions might be taken at elev. 245.00.

(b) Tailwater Elevation. - Under conditions described above under Condition No. 3 (b) this tailwater might fall to elev. 230.00.

(c) Ice Pressure. - Ice pressure under these conditions should be taken at 10,000 lbs. per lin. ft. of dam acting at elev. 245.00 minus 1.00 or at elev. 244.00."

- NOTE: The following paragraphs relative to headwater elevation and ice pressure under Condition No. 4 are from the original memorandum from Mr. Guy A. Lindsay, dated February 14, 1941:

"(a) Headwater Elevation. - The maximum headwater level occurring during the ice forming period would be on Jan. 1st, 1862 (Regulation Method No. 5) with a flow of 221,000 s.f.s. when the resultant headwater level would be elev. 244.9. To allow for future channel improvement, etc., the headwater level under these conditions should be taken at elev. 246.00.

"(c) Ice Pressure. - Ice pressure under these conditions should be taken at 10,000 lbs. per lin. ft. of dam acting at elev. 246.00 minus 1.00 or at elev. 245.00."

As may be seen above these elevations were altered by the subsequent memorandum from Mr. Lindsay dated April 26, 1941. As all drawings, plates and computations for stability had been completed and as an investigation showed that no change in design or sections would result from lowering the point of ice pressure by one foot, the plates and drawings have not been altered.

2-07. SUMMARY.

| Condition | Headwater | Tailwater | Head | Ice Pressure |
|---|---|---|---|---|
| 1 | 248.00 | 229.00 | 19.0 | Nil |
| 2 | 246.00 | 245.50 | 0.5 | Nil |
| 3 | 246.00 | 235.00 | 11.0 | Nil |
| 4 | 246.00 | 230.00 | 16.0 | El. 244.00 |

Condition 1 and 4 govern the design of the dam. Due to the possibility of any part of either gate leaf being in contact with the ice sheet both leaves are designed for the ice pressure of 2,500 pounds per square foot (the 10,000 pounds per lineal foot distributed over four feet vertically). Both gate leaves are also designed for the maximum hydraulic head differential of 19 feet.

2-08. UPLIFT PRESSURES. - The Iroquois Dam has been designed for uplift pressures of full headwater at the upstream face and full tailwater at the downstream face, the gradient between these two limits being taken as uniform and the pressures applied over two-thirds of the base area. Alternately, it has been designed for full tailwater pressure over the entire base area plus a differential pressure equal to 50 percent of the difference between headwater and tailwater at the upstream face, dropping uniformly to tailwater pressure only, at the downstream face. This second basis of design is the more severe of the two. Due to the fact that the pier footings are only 20 feet wide they were ignored in computing differentials between headwater and tailwater, the entire area of these footings being considered as receiving full tailwater effect.

## SECTION III UNIT STRESSES

3-01. The following unit stresses for concrete, reinforced concrete, and steel construction have been used in the design of the Iroquois Dam.

3-02. ST. LAWRENCE RIVER PROJECT

### Working Stresses for Concrete

| Nature of Stress | 3400 lb. Concrete Class A lbs/sq in. | 3000 lb. Concrete Class B lbs/sq in. | 2400 lb. Concrete Class C lbs/sq in. |
|---|---|---|---|
| 1. FLEXURE | | | |
| a. Extreme fiber stress in compression | 1225 | 1050 | 875 |
| b. Extreme fiber stress in compression adjacent to supports of continuous or fixed beams or of rigid ffames | 1400 | 1200 | 1000 |
| c. Extreme fiber stress in tension - Plain concrete only (to be used for massive sections not exposed to large temperature variations). | 70 | 60 | 50 |
| 2. AXIAL COMPRESSION | | | |
| a. In short columns with lateral ties (banded columns). | 785 | 675 | 560 |
| b. In short columns with continuous spirals | 980 | 840 | 750 |
| c. Pedestals-Unreinforced-Gross section | 875 | 750 | 625 |
| d. Composite Columns | 875 | 750 | 625 |
| 3. BEARING | | | |
| a. Load over entire area | 875 | 750 | 625 |
| b. Load over partial area | 1225 | 1050 | 875 |
| 4. COMBINED BENDING AND DIRECT STRESS - COMPRESSION IN EXTREME FIBER<br>In no case should the section be less than that required where axial load alone is considered, using stresses in 2-a and 2-b above. | | | |
| a. Spiral columns entire section in compression | 1225 | 1050 | 940 |
| b. Spiral columns-tension in section | 1225 | 1050 | 875 |

|  |  |  |  |
|---|---|---|---|
| c. Banded columns-entire section in compression | 1050 | 900 | 750 |
| d. Banded columns-tension in section (Short columns only, i.e. 1/r=40) | 1225 | 1050 | 875 |
| e. Arches | 1225 | 1050 | 875 |
| 5. SHEAR |  |  |  |
| a. Beams-No web reinforcement nor special anchorage of longitudinal steel | 70 | 60 | 50 |
| b. Beams-No web reinforcement-Longitudinal bars specially anchored. | 105 | 90 | 75 |
| c. Beams-Web reinforcement but longitudinal bars not anchored. | 210 | 180 | 150 |
| d. Beams-Web reinforcement and longitudinal bars specially anchored. | 315 | 270 | 225 |
| e. Flat slab-At critical section | 105 | 90 | 75 |
| f. Footings with hooked ends | 105 | 90 | 75 |
| g. Punching shear | 260 | 225 | 190 |
| h. Flat slabs-Beams at walls and openings-Torsional shear plus direct shear-Web reinforcement and longitudinal bars specially anchored | 525 | 450 | 375 |
| 6. BOND |  |  |  |
| a. Beams, slabs, and one-way footings (no special anchorage) |  |  |  |
| Plain bars | 140 | 120 | 100 |
| Deformed bars | 175 | 150 | 125 |
| b. Two-way footings |  |  |  |
| Plain bars | 105 | 90 | 75 |
| Deformed bars | 135 | 115 | 75 |
| c. Cold drawn steel wire | 70 | 60 | 50 |

Classification:

1. Class "A" Concrete shall be used for spillway bridge, and as shown on the drawings.
2. Class "B" Concrete shall be used in the bridge piers, or as otherwise indicated on the drawings.
3. Class "C" Concrete shall be used for the mass section of the dam.

## 3-03. Working stresses for Steel

(For stresses used in gate and crane design
see Sections VII and VIII)

| Nature of Stress | Maximum Stress | Formula Used |
|---|---|---|
| 1. TENSION | | |
| Rolled Steel, on net section | 18,000 | |
| On the area of the nominal diameter of rivets | 13,500 | |
| Tension in reinforcing steel | 18,000 | |
| 2. COMPRESSION | | |
| Rolled steel, on short lengths or where lateral deflection is prevented | 18,000 | |
| On gross sections of columns, with a maximum of | 15,000 | $\frac{18,000}{1+\frac{L^2}{18,000\,r^2}}$ |

in which L is the unbraced length of the column, and r is the corresponding least radius of gyration of the section, both in inches. For main compression members, the ratio L/r shall not exceed 120, and for bracing and other secondary members, 200.

3. BENDING

On extreme fibers of rolled sections, and built-up sections, not section, if lateral deflection is prevented-18,000

When the unsupported length L exceeds 15 times b, the width of the compression flange, the stress in pounds per square inch in the latter shall not exceed

$$\frac{20,000}{1+\frac{L^2}{2,000b^2}}$$

The laterally unsupported length of beams and girders shall not exceed 40 times b, the width of the compression flange.

On extreme fibers of pins, when the forces are assumed as acting at the center of gravity of the pieces - 27,000

| | | |
|---|---|---|
| 4. SHEARING | | |
| On pins | 13,500 | |
| On power-driven rivets | 13,500 | |
| On turned bolts in reamed holes with a clearance of not more than 1/50 of an inch | 13,500 | |
| On hand-driven rivets | 10,000 | |
| On unfinished bolts | 10,000 | |
| On the gross area of the webs of beams and girders, where h, the clear distance between flanges in inches, is not more than 60 times t, the thickness of the web in inches | 12,000 | |

On the gross area of the webs of beams and girders if the web is not stiffened where h is more than 60 times t, the greatest average shear per square inch, V/A, shall not exceed . . . . . .

$$\frac{18,000}{1+\frac{h^2}{7200t^2}}$$

in which V is the total shear, and A is gross area of web in square inches.

5. BEARING

| | Double Shear | Single Shear |
|---|---|---|
| On pins . . . . . . . . . . . . . . . . . . . . . | 30,000 | 24,000 |
| On power-driven rivets . . . . . . . . . . . | 30,000 | 24,000 |
| On turned bolts in reamed holes . . . . . . . | 30,000 | 24,000 |
| On hand-driven rivets . . . . . . . . . . . . | 20,000 | 16,000 |
| On unfinished bolts . . . . . . . . . . . . . | 20,000 | 16,000 |
| On expansion rollers per linear inch, 60 times the diameter of the roller in inches. | | |

6. COMBINED STRESSES. - For combined stresses due to wind and other loads, the permissible working stress may be increased 33-1/3 percent, provided the section thus found is not less than that required by the dead and live loads alone.

7. MEMBERS CARRYING WIND ONLY. - For members carrying wind stresses only, the permissible working stresses may be increased 33-1/3 percent.

8. SPECIAL LOAD STRESSES. - For members carry ice loads and temporary construction or erection loads the foregoing stresses may be increased. The conditions that prevail then are discussed in the Section describing the design of the structure involved.

# SECTION IV - CONCRETE

4-01. SCOPE. - This section of the analysis of design deals with the factors affecting design of the concrete to be used in the Iroquois Dam:

4-02. STRENGTH. - (28 day)

| Class | Average for any 25 Consecutive Cylinders |
|---|---|
| A | 3400 lbs. per sq. in. |
| B | 3000 " " " " |
| C | 2400 " " " " |

Class "A" concrete will be used for the pier houses, parapets, spillway bridge, and otherwise as directed. Class "B" concrete will be used for the bridge piers, training walls, spillway apron, or otherwise as directed. Class "C" concrete will be used for the mass section of the dam. In the outer five feet of the exposed dam surfaces and around conduits and other openings, the Class "C" concrete may be enriched by the use of additional cement.

4-03. All cement will be of the moderate-heat-of-hardening type conforming to the requirements of Federal Specification SS-C-206a. It is estimated that a five-foot pour will reach its maximum temperature in about three days. The specifications will require that an interval of five days elapse between the completion of one pour and the start of the next pour. It will also be made possible for the contractor to use artificial cooling methods to reduce temperature changes.

4-04. AGGREGATE INVESTIGATIONS. - Extensive surveys have been made of the sources of fine and coarse aggregates in the vicinity of the project. The results of these surveys are described in detail elsewhere in this report. (Paragraph 12-03 (d)).

4-05. AGGREGATE CONTENT.

(a) General. - The total volume of aggregates to be used in each cubic yard of concrete will be that necessary to produce a dense mixture of the required workability. The individual mixes will be based upon securing concrete having suitable workability, density, impermeability, and the required strength, without the use of an excessive amount of cement.

(b) Sizes.

(1) Course Aggregate will be graded and stored separately in 4 sizes, namely: a. 3/16" to 3/4"; b. 3/4" to 1-1/2"; c. 1-1/2" to 3"; d. 3" to 6".

(c) Tests. - Fine aggregate will be subjected to careful, thorough analyses to determine conformity with all of the foregoing and other specified requirements, including freezing and thawing and magnesium sulphate tests for soundness.

4-06. COARSE AGGREGATE. -

(a) Course aggregate may be washed gravel or crushed stone.

(b) Quality. - Coarse aggregate of standard quality will be required. An allowance is made for 5 percent of soft fragments, 1/4 of 1 percent clay lumps, and removal by decantation of 1 percent.

(c) Size. - For Class "A" concrete the maximum size aggregate shall be not less than 1½ inches; for Class "B" not more than 3 inches; and for Class "C" not more than 6 inches.

(d) Tests. - Both fine and coarse aggregates will be subjected to freezing and thawing tests and thorough tests to check their conformity with all requirements of the specifications.

4-07. MIXING WATER. - Reports from the U. S. Geological Survey indicate that St. Lawrence River Water is satisfactorily free from injurious chemicals and ordinarily free from excessive amounts of suspended silt, etc.

4-08. PROPORTIONING. -

(a) It has been assumed that the three classes of concrete to be used would have the following cement content per cubic yard:

| | |
|---|---|
| Class "A" | 5.0 to 6.0 bags |
| Class "B" | 4.0 to 5.0 bags |
| Class "C" | 3.0 to 4.5 bags |
| Concrete deposited in water | 6.5 bags |

(b) Water content and Consistency of Concrete. - In calculating the total water content in any mix, the amount of moisture carried on the surfaces of the aggregate particles shall be included. In all cases the amount of water to be used will be the minimum amount necessary to produce a plastic mixture of the strength specified and of the desired density, uniformity and workability. In general, the consistency of any mix will be that required for the specific placing conditions and methods of placement, and ordinarily the slump shall be between 1/2 inch and 2 inches for Class "B" and Class "C" concrete, and between 1-1/2 inches and 3 inches for Class "A" for "Method of Test for Consistency of Portland Cement Concrete", of the American Society for Testing Materials.

4-09. MIXING AND PLACING. -

(a) The contractor will be required to provide a complete modern and dependable mixing plant with a minimum capacity of 1200 cubic yards of concrete per 8 hours, equipped with automatic timers, weighing units, and means for measuring and indicating water entering the mixers.

(b) Placing. - Placing from bottom-dump buckets not exceeding 4 cubic yards in size will be required. Placing temperatures will be restricted to the range between 40 and 75 degrees (F). Artificial cooling or heating will be required when necessary. Thorough cleaning, dewatering and preparation of rock surfaces will be required before concrete is placed. Concrete courses in mass concrete are held to 5-foot maximum depth except near the crest of the dam. Initial courses and those placed after an interval of 15 days or more are restricted to a depth of 2 to 3 feet. Five days must elapse between the completion of one course before pouring can start on the next course. Special measures have been taken to terminate courses at details of discontinuity. Mechanical vibration of concrete is required.

4-10. CONSTRUCTION JOINTS. - Vertical construction joints, up to elevation 166.0, are to be formed with tongue and groove keys. Horizontal joints are to be continuous throughout all monoliths. Horizontal joint surfaces are to be cleaned and scrubbed before placing fresh concrete.

4-11. FINISHING. - Exposed concrete surfaces are to be given a smooth finish but rubbing with carborundum is not required.

4-12. ABSORPTIVE FORM LINING. - Absorptive form lining of approved type will be required on all permanently exposed formed concrete surfaces in order to insure a dense surface concrete. The present specification is modeled after that used for Caddoa Dam but provision is made for further investigation of this relatively new procedure.

4-13. EXPANSION AND CONTRACTION JOINTS. - Vertical expansion joints between monoliths are to be formed with vertical tongues and grooves with the outer edges of contact surfaces painted with asphalt. Waterstops will consist of a 6-inch diameter vertical channel halved by the joint and filled with plastic bituminous compound. A steam coil in each channel will serve to melt the filler, both during construction and later for maintenance. A metal strip will prevent the melted compound from reaching the face of the dam.

4-14. SEEPAGE DRAINS. - Vertical four-inch porous concrete tile drains are provided on six-foot centers near the upstream face of the dam. These drains will discharge into the inspection galleries, from which the seepage water will flow by gravity or be pumped to the tailwater below the dam.

## SECTION V - DESIGN

5-01. DESCRIPTION OF DAM. - The Iroquois Dam, as designed, is a series of pier buttresses supporting steel lift gates which extend to the river bottom, the sills being formed by blocks of mass concrete between the piers. The gate openings are 50 feet wide and the piers are ten feet thick at the dam axis. The spillway section, curved to a 1700-foot radius at the dam axis, extends from bank to bank of the present river channel and is flanked by solid gravity concrete bulkheads, each 193 feet long and keyed into earth wing dams which extend to high ground. The gate sills are at Elev. 200.00, which is approximate river bottom. Four gate openings at each end are filled to elev. 224.0 by concrete stoplogs. These are topped by single-section gates. The stoplogs were used for reasons of economy as the present river bottom is higher than Elev. 200 at the sides of the channel and it would have been useless to provide full-depth gate openings. However, if future experience in operating the dam makes desirable additional waterway area, the stoplogs can be pulled, the sides of the river channel cleaned out, and all 40 bays operated to sill elevation 200. The foundation rock is below the river bottom and comparative cost studies showed that the most economical construction would be the one employed. The top of gates is at Elev. 248.0, providing two feet of freeboard above the maximum probable water level. The top of the dam carries a 22-foot roadway bridge of reinforced concrete resting on steel girders, the steel box girders supporting the crane rails, and end supports, only, for a possible future standard-gauge railroad bridge. The end bulkheads are of gravity design and their downstream faces have been shaped to a "T" design to match the spillway piers. As the stems of the "T"s support the overhanging highway deck and contribute to the stability of the dam this buttressed effect is put to good use and need not be justified solely on the grounds of appearance. The east, or right bank, bulkhead contains gate storage and repair chambers and an electrical bay; the west, or left bank, bulkhead contains a second electrical bay.

5-02. DECK DESIGN. - The proposed deck layout puts the gantry cranes upstream from the highway bridge. The cranes span the two gate slots and the (future) railroad bridge between them. The downstream slot holds the gate in the regular working location. The upstream slot can be used in emergency, and for dogging a top gate leaf while the bottom is removed. The gantry cranes can, of course, work to or from a car on the railroad bridge, when and if the latter is erected. The cranes cannot work to or from the highway bridge.

The gantry girders span 50 feet clear, unsupported laterally. Single 6-foot plate girders would have carried the vertical loads, but difficulty was encountered in providing them with lateral strength. This is necessary to resist the stresses induced by the eccentricity of the crane rail, and by the outward force of the crane wheels traveling on an arc. It was therefore decided that the single plate alone was not so well adapted to this situation as was (1) a concrete-encased single-plate girder, or (2) a steel box girder. The former provides good appearance and low maintenance costs, but was rejected because of the very considerable dead load increment introduced. A box girder 5½'x3½' is used for each crane rail. The top cover plate is continuous between the two webs; the bottom is open. Under the top plate is a stringer (3 chords per girder span) bearing on the tops of cross beams. Angle frames constitute the cross bracing.

5-03. EQUIPMENT. - Guard houses with sanitary facilities below are provided at each end of the dam. All service conduits are carried over the deck of the structure. No grouting or service galleries are provided. Bulkhead compartments are thoroughly sealed and waterproofed but no joint seals or drains are employed in the spillway section. The gates are of the over-hung fixed-wheel, vertical lift type with upstream staunching rods on the top sections only. No seals are provided on the bottom sections. The gates will be operated by means of two travelling gantry cranes, one of which will have an auxiliary gas-electric generating unit included. Each of the 32 full-depth gates is divided into two sections of equal height to facilitate storage and handling. Gates are interchangeable, but a top section is not interchangeable with a bottom section. The 32 full depth service gate guides will be electrically heated, and casings are provided so that the easily-interchangeable heating units can be moved to the upstream or emergency gate slots if these are to be used.

5-04. GROUTING. - Because of the fact that the hydraulic head on this dam will ordinarily be very small no curtain grouting is provided for. The maximum design head of 19 feet will prevail for short periods only. The specifications are so written that, if necessary, pressure grouting may be done to consolidate faulty areas in the foundation. It is not expected that extensive grouting will be required.

5-05. DRAINS. - No foundation drains are provided. Any leakage which may find its way into the bulkhead compartments will be carried to sump pits and evacuated by pumping. The vertical monolith joints and horizontal construction joints at these bulkhead compartments are to be protected with seals where in contact with wetted surfaces.

5-06. GUARD HOUSES. - A small concrete guard house is placed at each end of the concrete dam. Access passages lead from each guard house to the service chambers within the bulkheads.

## SECTION VI - STRUCTURAL DESIGN

6-01. SCOPE. - This section describes the assumed loading, assumptions made, and stress analysis methods employed for various parts of the dam. At the present date only sufficient design has been completed to determine sizes and proportions of members.

6-02. COMPUTATIONS. - The computations are based on two-dimensional mechanics. The basis of design is explained in Section II.

6-03. SPILLWAY. - The spillway piers will require reinforcing from the deck down to a point several feet below the top of the sill. The entire 60 foot width of monolith, including the continuous mass concrete sill, is taken as a unit in resisting overturning. The rock in which the base is anchored to a depth of at least 5 feet is not considered as adding to the stability of the pier. While the railroad bridge will not be installed at this time it was assumed that it would be designed for E70 loading. The concrete highway bridge is designed for H-20 loading following standards of the U. S. Bureau of Public Roads and of New York State. The box girders supporting the crane rails each consist of two plate steel webs joined by cross beams and bracing which supports, at short intervals, a rail stringer beam which will follow the track curvature. It was found that this type of girder would save on height of structure and offer advantages in lateral stability and safety against derailment.

6-04. BULKHEADS. - The bulkhead walls are designed to resist maximum water pressure which may be brought to bear on them and are reinforced to cantilever from the base. Bulkhead decks are designed for E70 derailment within a zone which will be limited by the use of standard guard rail construction on the completed ballasted track. Outside of this zone the deck is designed for H-20 truck loading. It will be noted that each bulkhead monolith is a complete self-contained framework, separated from the adjoining monoliths by expansion joints. Seals in walls, deck and floor prevent leakage through these joints into the chambers inside.

6-05. EARTH PRESSURES. - The physical properties of earth fill were assumed as follows:

Dry weight =100 lbs per cu. ft.
Specific gravity =2.65
Void ratio =0.5
Angle of internal friction =33°

$$p = \frac{wh^2(1-\sin \phi)}{2\,(1-\sin \phi)}$$

Dry earth (liquid equivalent) = 32.5 lbs. per cu. ft.
Saturated earth and silt = 82.5 lbs. per cu. ft.

## SECTION VII - SPILLWAY GATES

7-01. GENERAL DESCRIPTION. - The spillway consists of forty openings each 50 feet wide. Thirty-two openings are equipped with gates 48 feet high in two 24-foot sections. Four openings at each end are closed by means of concrete stop-logs 24 feet high with gates 24 feet high resting on them. One extra top section and one extra bottom section are provided for spares. All of the gates are of the vertical lift, centilevered fixed-wheel type, with upstream skin plate and seals.

7-02. CHOICE OF TYPE. - The vertical lift type gate was selected for the following reasons:

(a) Normally, most of the gates would be in raised position and it is desirable to have the entire spillway opening clear.

(b) It was desired to provide a crest at El. 224.

(c) In the event a gate becomes stuck in any slot, a spare gate may be lowered in the other slot in the same opening to partially equalize the pressure on the jammed gate.

(d) For this height and span and under the prevailing hydraulic conditions, the vertical lift type is less costly than any other type. The cantilevered wheel design was chosen in order to keep the depth of the slot at a minimum and to eliminate the need for end rollers.

7-03. LOADS AND UNIT STRESSES. -

(a) Loading Conditions. - The loading criteria adopted were:

Condition I. - Headwater at El. 248 and tailwater at El. 229.

Condition II. - An ice load of 10,000 lbs, per linear foot of gate opening, distributed over a height of four feet and applied at any elevation on the gate, together with water load at a corresponding elevation. This condition assumes that either gate section may be dogged at various elevations so that it is possible for practically all of the gate to be within the maximum assumed ice range (El.227.5 to El.246).

(b) Unit Stresses, Condition I. - For Condition I the allowable unit stresses correspond to the 18,000lb. base for structural carbon steel in bending and to a 24,000 lb. base for structural silicon steel in bending. The thickness of all members is increased 1/16" over designed thickness to allow for corrosion.

(c) Unit Stresses, Condition II. - For Condition II the basic unit stresses are 150% of those for Condition I or 27,000 lbs. and 36,000 lbs., respectively, for structural carbon and silicon steel. No allowance for corrosion is made for this condition. The 50% increase in allowable unit stresses for Condition II, instead of the 25% allowed for the Long Sault gates, is believed justified because the importance of maintaining all of the gates at Iroquois is relatively much less than at Long Sault. Also, the normal position of the gates is so far downstream from the pier noses that there is less chance of a large mass of ice striking a gate; and, when ice forms above the gate, arch action across the opening is more likely to take place.

(d) Wheel Loads. - For Condition I a load of 180,000 lb. radially in combination with a thrust of 70,000 lb. is allowed on each wheel. For Condition II these loads may be increased 25%. These loads are the same as those allowed on the wheels of the Long Sault gates so that the same wheel design may be used.

## 7-04. STRUCTURAL DESIGN.

(a) Gates. - The gates will be mainly of structural carbon steel and of riveted construction except for calking and minor details where welding may be used. The end posts are of structural silicon steel. Silicon steel may also be used for horizontal girders, providing the deflection is kept within a reasonable limit. The waterload will be carried by skin plates and stiffeners into horizontal girders which frame into vertical end posts containing the axle bearings. Since vertical diaphragms are unusually heavy to distribute the ice loads and to support the dead load of the gate in handling, diagonal bracing will not be used.

(b) Track & Guide Rails. - The track rail on the downstream side of the slot rests on closely spaced wedges which are adjusted to obtain the correct track alignment. A light rail on the upstream side guides the gate by contact with the wheels as it is lowered under no load.

7-05. SEALS. - The seals are placed on the upstream side for the following reasons:

(a) The gate tracks are long (62 feet) making adjustment of the track rail in an up and downstream direction desirable. If the seals were placed on the downstream side, a variation in distance from gate to sealing surface equal to the required adjustment in the rail would result.

(b) The differential in head will not be great, especially during the time when ice may be expected, hence most of the wheels will be submerged when a gate is seated.

(c) Since the gates are ordinarily open, it is desirable to have as great a radius as possible on the downstream corners of the gate slots to deflect ice and other floating material and to offer a smoother surface to the flow of water along the piers. Since it is not necessary to close any opening watertight, staunching rods are placed on the sides of the top section only. This is in order to prevent the flow of water around the wheels above tailwater where freezing would cause trouble in operation. It is expected that the joint between the gate sections will always be submerged at least five feet below tailwater. Hence no horizontal seals are required.

7-06. WHEELS. - The wheels are of rolled steel, double flanged, 30 inches in diameter, with heat-treated treads and roller bearings. A centralized greasing system will provide lubrication for the wheel bearings at each end of each gate section. The wheels will run on heat-treated crane rails set vertically in the slots on the downstream side. A guide rail is provided on the upstream side. There is sufficient slip on the axles to allow for variation in length of gate due to temperature and for tolerances in track setting.

## 7-07. LIFTING AND COUPLING MECHANISM.

(a) Description. - A double hook near each end of each lower gate section is engaged by a pair of swinging links, hinged from a crosshead and connected by silicon steel bars to similar hooks at the top of the upper gate section. When lifting the two sections together the lifting beam links engage the upper hooks, lifting the lower section through the tie bars and lower hooks. The upper gate section rests upon the lower section. The coupling mechanism is locked by means of wedges near the top of the upper gate section.

(b) Operation. - The gates are disconnected by first engaging the upper hooks with the lifting beam and hoisting until the load is taken off the wedges. The wedges are then withdrawn by means of electrically operated screw devices, after which the links at the bottom of the cross-head are disengaged from the lower hooks, by lowering the cross-head a short distance. The upper section may then be raised clear of the lower section. The crane operating crew thus has full control of latching and unlatching the two gate sections. The gate sections are centered for coupling by means of guide pins on the bottom of the upper section which engage guide sockets in the top of the lower section. The lift beam is centered similarly as it is lowered to the top of the gate.

## 7-08. PROTECTION AGAINST ICE.

(a) Heaters. - Three vertical riser electric heaters of 4 kw. capacity each will be installed in pipe casings in the piers in the downstream slots for all service gate. One heater is located back of the sealing surface on the dam and the other two back of the liner plates in the slot. Each heater is encased in a 3½" diameter standard steel pipe embedded in the concrete. The heaters are active between El. 225 and El. 252, the upper part of the active length being for the purpose of melting ice deposits due to spray and to keep the gate dogs free of ice.

(b) Air Bubblers. - For preventing the formation of ice on both sides of the gate, air bubblers connected by flexible hose to the air supply on the dam will be placed near the bottom of the top gate section, with one set of nozzles discharging upstream through the skin plate and a second set discharging downstream.

7-09. DOGS. - The gates will be held in open position by means of retractable dogs which engage the treads of the over-hung wheels. The reactions from the weight of the gate are carried vertically into steel grillages in the piers. The dogs pivot on horizontal pins and are operated individually by means of hand levers at the tops of the piers. Each pair of dogs is designed to support a load of 150% of the weight of the gate in air.

## 7-10. OPERATION.

(a) Gates. - The gates will be handled by either of two traveling gantry cranes. Each gate may be lifted in the slot with the section coupled and may be dogged on any pair of wheels (except the bottom pair on the top section) permitting the discharge of water between the bottom of the gate and the sill. The minimum opening would be approximately 7'3". If discharge between the gate sections is required, the top section may be uncoupled and dogged on any pair of wheels with the minimum opening between the gate sections also about 7'3". When a clear gate opening is required, the top section will be dogged above headwater in the upstream slot and the bottom section in the downstream slot.

(b) Bubblers and Heaters. - In cold weather the air bubbler system will be kept in operation to prevent ice formation against the gates. The heaters will be run at partial load to prevent ice forming in the slots, or will be turned on to melt ice already formed before the gates are operated.

7-11. REPAIR OF GATES. - Recesses are provided in the east bulkhead for the double purpose of permitting storage of the one complete extra gate, and for the repair or repainting of any gate. These recesses are protected from the elements, and contain machine shop facilities which will make it possible to remove wheel assemblies and make any repairs likely to be required. The labor saved will probably make it advantageous to move the service gates to this point for maintenance painting.

# SECTION VIII - GANTRY CRANES

## 8-01. LOADS, UNIT STRESSES AND SPEEDS.

(a) Two travelling gantry cranes are provided for the operation of the spillway gates. The 225-ton capacity of the main hoist for each crane is determined by the estimated maximum lifting load on a full gate plus the weight of the lifting beam. The capacity of the auxiliary hoist on each crane was set at 10 tons, that being considered a safe maximum weight for any movable equipment on the dam except the gates.

(b) The following loading conditions were considered:

(1) For gantry in operating condition, dead load + live load + impact + tractive force + 10 lb. per sq. ft. wind load.

(2) For gantry in static condition, dead load + live load + 30 lb. per sq. ft. wind load.

(3) For gantry in operating condition, dead load + live load + collision.

(4) For gantry in operating condition, dead load + breakdown torque of main hoist motor acting through one drum.

(5) For gantry in static condition, dead load + 40 lb. per sq. ft. wind load. (For stability only)

(c) Condition 1 is considered a normal operating condition. For Conditions 2 and 3, unit stresses 25% in excess of those for Condition 1 may be used. For Condition 4, unit stresses up to 90% of the elastic limit of the materials involved are allowed. Condition 5 must show a factor of safety against overturning of at least 2.

(d) The allowable unit stresses for Condition 1 conform to the American Institute of Steel Construction's Specification for the Design of Structural Steel for Buildings, revised 1936, except that all stresses are proportionately reduced in the ratio of 1 ,000 to 20,000.

(e) Speed of operation is not considered of prime importance in handling the gates, hence gantry travel, trolley travel and hoisting speed are moderate. The speeds adopted are:

| | | | | |
|---|---|---|---|---|
| Gantry Travel | 75 | feet | per | minute |
| Trolley " | 15 | " | " | " |
| Main hoist speed | 2 | " | " | " |
| Auxiliary hoist speed | 15 | " | " | " |

## 8-02. DESIGN.

(a) Each gantry frame is rectangular in plan with the trucks skewed to follow the curved tracks. The portals are designed as rigid frames hinged at the rail heads and the side frames are braced diagonally. The operator's is located at one end of the crane and access is by means of ladders to a platform along the lower downstream sill and thence to another platform at the cab floor level. The trolley and track are completely enclosed by a sheet steel housing.

(b) The cranes were designed with a view to making the exterior appearance as pleasing as possible. Long horizontal louvres in the trolley housing, curved gusset plates, and covers over the gantry trucks and drive motors are some of the features intended to improve the appearance of the structures.

(c) The two main hoist drums are mounted on a single trolley and are spaced so that the sheave blocks are directly above the hooks on the gates when the gate is centered over a gate opening. The auxiliary hoist is mounted between the main hoist drums and is equipped with a single crane hook. The main hoist sheave blocks are connected to moving cross heads in a lifting beam, and swinging links at the bottom of each cross head engage the lifting hooks on the gates. The lifting beam is guided by the rails in the gate slots.

(b) All motors are of the wound rotor type and are equipped with electric shoe-type brakes. Each gantry truck is driven by an individual motor concealed at the inner end. The main hoist drums are driven by a single motor on a flexible-coupled shaft. One crane, only, is equipped with a gasoline-electric auxiliary power unit.

8-03. OPERATION. - Each crane is used to lift or lower the spillway gates under full water load differential, to move them in an up-and-downstream direction within the limits of the trolley travel, to transport them along the curved runway over the spillway and east bulkhead, and to perform miscellaneous service on the dam. The power take-off for both cranes is from conductors in a continuous slot on the upstream side of the spillway bridge.

## SECTION IX - ELECTRICAL DESIGN

9-01. PRIMARY SYSTEM. - In the interest of reliability two sources of power will be provided, one from the American side and one from the Canadian side. Power will be supplies through two primary feeders to each end of the dam. By the use of a secondary network throughout the dam, fed from each end by network transformers through network protectors, power can be taken from either end or both ends at the same time, since the network protectors will open when power flows through them in the opposite direction to its normal flow. Since the network protectors are automatically reclosing, when a fault on a feeder is removed, the feeder is put back into operation with a minimum of delay. In case of a failure of one or more feeders or transformers, the others will automatically take over its load, making a complete outage extremely unlikely.

9-02. SUBSTATIONS. - A small transformer substation will be installed in the bulkhead chambers at each end of the dam, to step the incoming power down to 480 volts. Each substation will consist of two 225 kva network transformers with network protectors. Each transformer will be connected to an individual incoming feeder through disconnecting switches capable of breaking the exciting current of the transformer. The secondaries will be connected in parallel through the network protectors to the 480 volts, 3 phase, secondary network. The transformers will provide a total capacity of 1,000 kva, continuous rating, 500 kva from each end of the dam. With one transformer or feeder out, the capacity will be 750 kva, which will be sufficient for normal operation.

9-03. SECONDARY NETWORK. - In order to obtain the greatest possible reliability with a minimum of cable, power loss, and voltage drop, a network will be provided to distribute power from the sub-stations to the various loads. By the use of a network, all conductors are useful on all loads, so that the greatest possible advantage is taken of the diversity of the loads. A failure of a cable will not put any part of the system out of operations, since the cable on which the fault occurs will be automatically isolated, and the remaining cables will take over its load.

Three circuits, each consisting of three 0000 AWG cables, rubber covered, will be provided throughout the dam. Metal- enclosed buses will be provided at each substation and at each odd numbered pier between 5 and 35, to which the network cables will be connected through copper link fuses. All branch circuits will be taken from the buses through copper link fuses and air circuit breakers.

9-04. GANTRY CRANES. - There will be two gantry cranes. The connected load on each will consist of a 100-HP wound rotor induction motor for hoisting, 4-25 HP wound rotor induction motors for traveling, and a 25 kva lighting transformer. Interlocks will be provided to limit operations to one motion at a time. Both cranes will take their power from a single bus located in a recess in the upstream face of the dam. The bus will be divided into four sections of approximately equal length. Each section will be connected to the 480-volt secondary network through a 500-ampere air circuit breaker, and to each adjacent section through 300-ampere fuses.

9-05. HEATERS. - The gate opening heater load will consist of 24 kw per opening. The total connected heater load for the 32 gate openings equipped with heaters is 768 kw. A 50-ampere branch circuit will be provided for the heaters of each gate. A 50-ampere air circuit breaker in each branch circuit will provide a means of turning the heaters off and on, and a single-pole switch in one phase of each branch circuit will provide a means of reducing the heat to 50%.

9-06. LIGHTS. - A 15-kva lighting transformer will be provided in each substation. A lighting panelboard will be provided with each transformer, from which branch circuits will be taken to the guard houses, bulkhead chambers, and roadway lights. 100-watt roadway balustrade light will be located every 60 feet on each side of the roadway. These lights will be connected in two 25-ampere 3-wire feeders, and will be controlled by two automatic time switches. Individual 15-ampere fused branch circuits will be provided for each light.

# SECTION X - STABILITY

10-01. GENERAL. - The Iroquois Dam was analyzed for stability by the application of loadings due to cases 1 and 4 (See Section II) with hydraulic uplift on the full foundation area assumed (first) as being equal to tailwater pressure at the downstream toe increasing uniformly to tailwater plus half of the difference between headwater and tailwater at the upstream face; and (second) as being equal to two-thirds of tailwater at the downstream toe and two-thirds of headwater at the upstream face, with uniform gradation between these limits. In the investigation of monolith stability the only horizontal forces considered were those due to head differential and to ice. Wind forces were disregarded because large areas would be exposed only with the pool empty, and the dam would then be in the lee of the cofferdam. Vertical forces considered include weight of concrete, weight of an uplift on gates, downwater on sill and on pier batter, weight of gantry girders and highway bridge, and uplift as described above. The effects of gantry cranes and railroad bridge and loading were disregarded because all of these will produce a moment resisting overturning. Highway live load was disregarded because it is indefinite and relatively small. Bearing stresses are low in all parts of the dam (maximum: 140 lb. per square inch) and design was fixed by avoiding tension at toe and heel. All sections are stable bay by bay with the gate piers tied into the continued base by reinforcement.

10-02. MONOLITHS. - The low spillway crest, at mean river bottom elevation, permits the use of an entire 60-foot bay as a monolith in computing stability. The bulkhead sections are divided into approximately 60-foot monoliths to match the appearance of the spillway. During second-stage construction the completed portion of the dam will serve for diversion.

10-03. SPILLWAY. - It had been determined by the Advisory Board that the spillway should be a continuous concrete sill at approximate mean river bottom elevation. The reinforced piers are tied into this sill and expansion joints are placed halfway between adjacent piers. The sill has been made just wide enough to serve the gates whether the latter are used in the service or emergency guides. The piers are placed on individual spread footings in order to secure the greatest possible degree of stability with the use of a minimum of material.

10-04. STABILITY DIAGRAMS. - The complete stability diagrams are presented in this section.

Plates X-1 to X-4 show stability of the spillway monoliths for two governing conditions and for the two alternative assumed conditions of hydraulic uplift. Plate X-5 assumes the gate in the downstream slot, and illustrates an investigation of the effect of allowing tailwater to be drawn down to create a higher overturning head than that used for the design. This plate was made primarily to show the stability inherent in the shape of pier and sill used with the gates in the downstream slots. Note that the resultant does not pass without the middle third of the pier monolith until the tailwater elevation has dropped to Elev. 220 with headwater at Elev. 248. This 28-foot head differential is 47 percent greater than that actually required by the design criteria, and the tailwater would have to be 9 feet lower than the normal flow elevation of the river surface, with no obstruction at the powerhouse. Plates X-6 to X-13 show stability conditions for the east and west bulkheads. In designing these bulkheads advantage has been taken of the "T" shape of the monoliths.

The spillway section is stable as a gravity dam from a point a few feet below the sill on down to the greatest depth encountered. The assumption of two-thirds uplift is less severe than the alternative uplift described, but no appreciable economy could be effected by putting the design on the two-thirds uplift basis because the physical requirements of the gates and their operating equipment would still require a structure of approximately the proportions shown. Considerable economy has been secured by using a "T" shape for all monoliths rather than a uniform section of standard gravity type. Reinforcement will be required for the gate piers down to a level several feet below the top of the sill but the percentage of steel will be low and no other reinforcement will be necessary except for the roof and walls of the bulkheads.

# SECTION XI

## COFFERDAMS AND DIVERSION

### 11-01. HYDROLOGY.

(a) General. - The St. Lawrence River has its source in the Great Lakes System. By far the greater portion of the runoff from the tributary area above the Iroquois Dam passes through the lakes, which function as regulating reservoirs to such extent that the flow of the river is not subject to extreme variations. For this reason, it is considered that the design of the hydraulic features of the dam can be predicated wholly on the records of past flows, which are available for the period 1860 to date (Plate XI-I), and no further hydrological studies or studies of maximum floods have been made. A memorandum summarizing data received from the Canadian Engineers, and believed to be of general interest, is attached hereto as Exhibit I.

### 11-02. CONSTRUCTION AND DIVERSION PROGRAM.

(a) General. - The Iroquois Dam is to be located across the channel of the St. Lawrence River a short distance upstream from the town of Iroquois, Ontario. The river at this point flows through a single channel, and it is proposed that first one-half of the channel be closed by cofferdams while the enclosed section of dam is constructed; then the other half. During the first stage, the river flow will be continued in the open section of channel and during the second stage the river flow will be passed through the gate bays of the completed section of dam. The layout of the dam, which provides for gate bays with sills at the approximate present average river bed elevation, makes it unnecessary to provide other diversion openings in the structure. The general layout is shown on Plate XI-2.

(b) Order of Work. - The general configuration of the river in the vicinity of the damsite is such that it would be somewhat simpler to construct the section of dam adjacent to the Canadian shore as the first construction stage. However, the primary source of available rock is the Point Rockway Canal excavation, which is on the U. S. side; and it is proposed to construct the U. S. section of the dam first so that it may be used as an access road to the remainder of the work. The contractor will be permitted, however, to make his own choice in the matter.

### 11-03. COFFERDAMS.

(a) General. - The construction plan provides for enclosing each stage of the work within cofferdams so that the entire work area may be unwatered. Average bedrock in the area is at approximate elevation 170, top of river bed overburden varies from elevation 190 to elevation 225, and the maximum water surface elevation will be about 234. The depth of water thus varies from about 9 feet to about 44 feet. The depth of overburden varies from about 20 feet to about 70 feet.

(b) Cofferdam Foundation Conditions. - The foundation overburden beneath the cofferdams is variable, ranging from impervious clayey silt to pervious sand and gravel. The general distribution of the various types of overburden materials, determined by the foundation exploration recounted in Section XII, is described in paragraph 13-02(c).

(c) Type of Cofferdams. - Consideration has been given to several types of cofferdams, predominent among which were rock and earth embankment, steel sheet piling, and timber crib. Of these the rock and earth embankment is the least expensive in locations where available space and velocities of river flow permit its placing and maintenance; and this type has been used when practicable. However, in the river arms and in some sections of the upstream and downstream arms, both space and velocities prohibited the use of earth or rock embankment; and it was necessary to provide a different type for these locations. The steel sheet pile has the desirable feature of penetrating the overburden and sealing off seepage; but the maximum height required above river bed would cause interlock stress to approach the maximum desirable limit and the presence of numerous boulders in the overburden would make driving difficult. For these reasons, together with probability that steel sheet piling in large quantities will be exceedingly difficult to obtain, it was decided that the use of steel piling would be limited to small quantities to be used as a sealing membrane. The final selection, shown on the general cofferdam layout (Plate XI-2) provides for a combination timber crib and earth and rock embankment cofferdam.

(d) Cofferdam Layout. - The division of the dam into two construction sections, and the layout of the cofferdams enclosing these sections, has been made to provide equal flow areas during each stage. The first stage includes that portion of the dam from the U. S. abutment to and including pier 21. The second stage includes the remainder of the structure. The cofferdams are founded on the river overburden; and, in order to protect the excavation, the cofferdams are in general located not less than 200 feet from the limits of the dam except for sections protected by steel sheet piling or constructed within the unwatered area. These latter sections are located so that a berm of not less than 30 feet may be left adjacent to the cofferdam with slopes not steeper than 1½ to 1 extending to the bottom of the excavation. Several cribs of the upstream and downstream arms of the second stage cofferdam, adjacent to the cribs of the first stage cofferdams, are to be built as a part of the first stage to protect the river arm against scour; and supplementary cribs are provided off the river arm for the same purpose. Likewise, several cribs of the first stage cofferdam will be left in place during the second stage construction for protection against scour. The layout of the river arms of the cofferdams foreach stage is shown on Plate XI-3.

(e) Cofferdam Design.

(1) Timber Cribs. - Timber cribs will have a width, in general, equal to or greater than the height; but in no event less than 0.9 the height. Consideration of the various crib heights together with the material quantities and handling costs led to the adoption of a standard 10-foot pocket using 10" x 10" timber. No special boltings will be required as the cribs are relatively shallow and the rock fill will arch. 28" x 7/8" square drift pins will be used at the joints; 2 pins across each joint. A 2-inch sheathing will be placed on the water face of all cribs, except at special sections protected by sheet pile, and the water seal provided by an impervious fill placed against the crib. For the river arm of the first stage cofferdam where it is desired to permit excavation closer to the cofferdam, the 2" sheathing will be replaced by steel sheet piling driven through the overburden to seal the overburden and offer added protection against scour. The river arm of the second stage cofferdam is a bulkhead section to be built in the dry to connect the second stage cofferdams to the completed section of the dam and will be protected by a built-up water-tight sheathing. Inasmuch as this section is built in the

dry, the condition of the river overburden and the need for a sheet pile cut-off can best be determined at the time of construction. A typical crib is shown on Plate XI-4.

(2) Rock and Earth Embankment. - A large quantity or rock will be available from the Point Rockway Canal excavation, and this rock has been included in the cofferdam embankment to provide for easier placing of earth fill and to permit the extension of the embankment fill to limits where the velocity of flow might otherwise prevent placing of earth fill. Rock fill will be placed to the surface of the water in order to reduce the flow sufficiently to permit placing earth, then the impervious earth will be placed against the water side of the rock fill. Rock fill will have 1:1 slopes on the water side and 2:1 slopes on the dry side. Earth fill will have 3:1 slopes and 20-foot crown. Impervious earth embankment placed against the water side of the cribs will have a 3:1 slope. All earth embankment, including fill against cribs excepting where sheet piling is provided, will have a toe trench to be bank-filled with impervious materials. It is not considered that information as to the actual composition of the overburden throughout the area has been sufficiently developed to permit delineation of the depths to which such toe trenches must be excavated at definite locations; and it is anticipated that these data will be determined during construction. Embankment fills in the vicinity of the river arms will be protected by riprap; otherwise riprap protection is not believed needed. The embankment against the river arm of the first stage cofferdam will be protected against scour by a toe fill of derrick stone. A typical embankment section is shown on Plate XI-4.

(f) Removal of Cofferdams. - Inasmuch asthe sill of the dam is to be at elevation 200, it will be necessary to remove all cofferdams to this elevation in order to provide for the full efficiency of the structure. A portion of the upstream arm of the first stage cofferdams lies across the area to be dredged for the approach to the Point Rockway Canal and this section must be completely removed.

(g) Cofferdam Materials. - In order that the timber for cofferdam cribs might be ordered previously to the final letting of the contract so that construction may be more quickly initiated, it is planned that the Government will furnish cofferdam timbers. For the same reason, as well as for the reason that materials made of steel are difficult to obtain, it is proposed that the Government furnish materials such as drift pins, bolts, etc. The contractor will be required to furnish steel sheet piling, since used piling will be satisfactory and most contractors will have or will be able to obtain the limited amount of piling required. Borrow areas for earth fill have been designated on the plans, while a plentiful supply of rock will be available from the Point Rockway Canal cut.

## 11-04. HYDRAULIC CONDITIONS.

(a) General. - No particular problems involving flow past the site are involved. The present velocity of flow past the site at average discharge is about 4.5 miles per hour or 6.6 feet per second. Inasmuch as the cofferdams have been laid out to provide about equal areas for flow during each construction stage, the flow area will be half the present area and the velocity will be doubled, creating an average swell head of about 0.7 feet. The maximum swell head will be approximately one foot. The elevation of the upstream and river arms of the cofferdams has been placed 2 feet higher than that of the downstream arms. The elevation of the downstream cribs, in turn, is set at two feet above the highest stage of record (elevation 233) or elevation 235.

while the downstream embankments have a 4-foot freeboard above the maximum stage. Since the river is not subject to floods, and since the site of the dam is at a location which is not subject to backwater from ice gorges, no protection against higher stages is provided.

### 11-05. EFFECT ON OTHER CONTRACTS OR FACILITIES.

(a) Other Contracts. - No other contracts will be affected by the cofferdams and diversion, except that the water surface elevation in the vicinity of various channel cuts below the Galop Island will be raised by about 1-foot or less.

(b) Navigation. - Normally, navigation proceeding upstream past the site of the work enters the Galop Canal at Lock 25 downstream from the dam while navigation proceeding downstream leaves the Galop Canal at Locks 27 and 28 upstream from the site of the dam and follows the river channel past the damsite. During the first stage of construction, it may be desired to continue downbound navigation past the damsite since velocities in the constricted channel will not be materially increased over those existing in the narrow channel immediately below the damsite. In this event it will be necessary to require that the contractor maintain proper lights and signals on his structures and that he maintains the channel free from obstructions. Otherwise, navigation will be affected during construction only in that down-bound as well as up-bound vessels must proceed throught the entire Galop Canal. The Galop Canal system will not be affected by the construction of the Iroquois Dam until the pool is raised, at which time Lock 25 will have been raised or possibly abandoned.

## SECTION XI - Exhibit 1

Subject: Hydraulic Data and Results obtained from Canadian Engineers.

1. A considerable amount of work in connection with compiliation of hydraulic data has been done by the Canadian Engineers, particularly by Mr. Guy A. Lindsay of the Department of Transport. This memorandum summarizes portions of the data furnished which it is believed will be of general interest.

### RELATION BETWEEN PRECIPITATION AND SUPPLIES TO THE GREAT LAKES

2. Description of Watershed. The drainage areas, water surface areas and the equivalent in cubic feet per second per month of one foot storage of each of the Great Lakes are as follows:

| Lake | Drainage Area sq. miles | Water Surface Area sq. miles | Equivalent of 1 foot storage per month c.f.s. |
|---|---|---|---|
| Superior | 80,900 | 31,820 | 337,300 |
| Michigan-Huron | 147,880 | 45,410 | 481,300 |
| Erie | 34,680 | 9,940 | 105,400 |
| Ontario | 34,630 | 7,540 | 79,900 |
| Totals | 298,090 | 94,710 | 1,003,900 |

3. Precipitation. The controller of the Meteorological Division of the Air Services Branch of the Department of transport has prepared data on the precipitation on the watershed of the Great Lakes extending from 1871 to 1938 inclusive. In compiling this data, the watershed was divided into sections, the precipitation in each section obtained by taking the mean of the precipitation reported from all stations in the section, and the precipitation on the total watershed was based on the weighted mean of that in each section. The total number of stations from which records were available varied from 22 in 1871 to 177 in 1919.

4. Table No. 1, attached hereto, shows the total precipitation for each climatic year, i.e., November 1st to October 31st, from 1871 to 1938. This is also shown in diagrammatic form on Diagram No. 2190. The total annual precipitation has varied from a maximum of 39.69 inches in 1879 - 80 to a minimum of 25.90 inches in 1894 - 95. The avarage over the whole period has been at the rate of 31.22 inches.

5. Supply. The annual net supply to the entire Great Lakes System, from 1860 to 1939, has varied from a maximum of 339,000 c.f.s. in 1873 to a minimum of 149,000 c.f.s. in 1895, with an average for the entire period of 238,000 c.f.s.

6. The seasonal variation in supply swings between wide limits, being highest in the spring months and lowest in the fall. The average monthly net supply by months, from 1860 to 1939, has been as follows:

| Spring and Summer | | Fall and Winter | |
|---|---|---|---|
| March | 373,000 c.f.s. | August | 165,000 c.f.s. |
| April | 530,000 " | September | 83,000 " |
| May | 532,000 " | October | 40,000 " |
| June | 423,000 " | November | 28,000 " |
| July | 290,000 " | December | 64,000 " |
| | | January | 113,000 " |
| | | February | 215,000 " |
| Average | 430,000 c.f.s. | Average | 101,000 c.f.s. |

7. The maximum monthly net supply was at the rate of 829,000 c.f.s. during May, 1916. During November, 1867, the draw on storage in the lakes was 175,000 c.f.s. in excess of the net supply.

8. Relation between Net Supply and Precipitation. The period from 1871 to 1938 has been divided into two periods from which the following data, showing the relation between supply and precipitation to the Great Lakes, has been deduced.

| | Period<br>1871 to 1905 | Period<br>1905 to 1938 |
|---|---|---|
| Average annual net supply | 242,000 c.f.s. | 229,000 c.f.s. |
| Total annual precipitation | 31.99 inches | 30.43 inches |
| " " " | 702,000 c.f.s. | 668,000 c.f.s. |
| Net Supply as percent of precipitation | 34.4% | 34.3% |

9. "A number of studies have been made by several engineers on the regulation of Lake Ontario in connection with the development of power on the St. Lawrence and these studies show that the benefit to power operation obtained by any of them is not great." (Joint Board Report 1926)

10. Mr. Lindsay, in his recent studies, used the same basic data as the Joint Board, increasing the net supply as computed by 10,300 c.f.s. to compensate for the reduction of the diversion at Chicago from 8,500 c.f.s. (assumed by the Board) to 3,200 c.f.s. (present diversion) and the addition of 5,000 c.f.s. from the Ogaki River and Long Lac watersheds into Lake Superior as contemplated by Ontario. Mr. Lindsay also used the "Discharge-Stage Relationships" for the various locks (copies of which were attached to a memorandum from Mr. Lindsay to the District Engineer, dated September, 1940) and data obtained from the U. S. Lake Survey water levels at Oswego

referred to the 1935 datum.

The following essential requirements for the regulation of Lake Ontario were used by the Joint Board:

(a) To keep the fluctuations of the levels of Lake Ontario within the levels that it has had in the past.

(b) To maintain, without impairment, the low water levels of Montreal Harbour.

(c) To maintain low flows during the winter period December 15 to March 31, in order that the difficulties of winter operation may not be aggravated.

(d) To maintain flows during the first half of April no greater than would naturally occur, in order to avoid the danger of aggravating the spring rise during the breakup of the ice below Montreal.

(e) To avoid any material increase in the amount and duration of the high discharges during May, in order not to aggravate high water heights in Lake St. Louis during the Ottawa floods.

(f) To hold back the natural excess outflow during the early summer months, in order to raise the ordinary levels of Lake Ontario.

(g) To secure the maximum dependable flow throughout the year for power operation.

To these requirements Mr. Lindsay added the following additional one:

(h) To keep the fluctuation in monthly mean discharges within the limits as existed in nature.

11. Rule curves were established for various operation schedules and applied to conditions as existing in the past in an attempt to meet all regulation requirements, but in general it was found that one requirement could be completely satisfied only at a sacrifice in the degree to which others were met. Of all the schedules and variations studied, the adopted schedule, identified as method No. 5, seemed to best meet all requirements.

12. By the application of Method No. 5, to the corrected values of the net supply Mr. Lindsay has computed monthly mean discharges and lake levels for the period 1860 to 1939. On Plate XI-A are shown the Discharge Duration Curves, Curve A being for natural conditions and Curve B for regulation under Method No. 5.

The mean and extremes compared with actual is as follows:

| | Regulated Method No. 5 | | Actual |
|---|---|---|---|
| Mean discharge | 242,000 c.f.s. | | 237,000 c.f.s. |
| Minimum monthly discharge | 180,000 " | (Nov.1939) | 144,000 " |
| Maximum " " | 310,000 " | | 314,000 " |
| Mean lake level | 246.43ft. | | 245.96 ft. |
| Minimum monthly mean | 244.73ft. | (Nov. 1934) | 242.68 ft. |
| Maximum monthly mean | 249.10ft. | (May 1870) | 249.02 ft. |

## BACKWATER CALCULATIONS AND HYDRAULICS

13. Backwater computations have been made for both open water and ice conditions to determine the slope required for a given discharge and lake level, and from this information and the regulated flow, according to Method No. 5, the head and tailwater elevations and the head and power available have been calculated for each month from 1860 to 1939. This information has been summarized in the form of curves on the attached sheets.

Plate XI-B. "Power and Head Duration Curves".
Plate XI-C. "Envelope of Minimum and Maximum Heads and Power available for various Discharges and Percent fo Time".

14. Profiles indicating natural water surface profiles and the extremes of the calculated backwater profiles are shown in:
Plate XI-D. "Tentative Backwater Profiles".

15. In computing the available heed during the winter months, it was necessary to make certain assumptions as to ice conditions and effects of ice conditions. Mr. Lindsay assumed "that the backwater slopes during January and February would be those resulting from ice cover conditions; during April to December 15th open water conditions; and during March and the second half of December the average of open water and ice cover conditions".

16. "It was (also) assumed (by Mr. Lindsay) that during January and February the tailwater levels would rise 5 feet above open water conditions and during March and the second half of December tailwaters would be an average of open and ice conditions. Plate XI-E shows the tailwater curve for both open water and for assumed ice cover conditions."

# SECTION XII

## INVESTIGATIONS OF FOUNDATIONS AND MATERIAL FOR DAM, EMBANKMENTS, AND CONTRETE AGGREGATES.

12-01. FIELD EXPLORATION OF FOUNDATIONS PRIOR TO OCTOBER 1940.- Prior to October 1940, the Governments of Canada and the United States and various private companies made investigations in the vicinity of the Iroquois Dam Site for the purpose of determining the foundation conditions. Most of the field exploration was of a preliminary nature for the purpose of studying various plans and layouts of the project as a whole. Exploration consisted of drilling holes through the overburden by wash boring method and into the bedrock with core bits. Some of the field logs of the drilling done between 1919 and 1930 are on file in the district office. The location of all drilling prior to October, 1940, is shown on Plate XII-1, and the record of exploration made between 1925 and 1935 is shown on Plate XII-2.

12-02. FIELD EXPLORATION OF FOUNDATIONS SINCE OCTOBER 1940.

(a) General. - Foundation exploration at the dam, wing dams, and cofferdams since October 1940, conducted by the U. S. Corps of Engineers for the purpose of obtaining information for final designs included extensive geological reconnaissance, drilling in overburden and rock, excavation and sampling of test pits, test trenches, and auger holes, and the determination of bedrock elevations by the seismic method. The location and extent of the exploration at the sites are shown on Plate XII-1. Complete reports of the drill holes, and notes and computations of the seismic investigations are on file in the district office. Records of the drilling and test pit information are shown on contract drawings QD-1-1/5, QD-1-1/6 and QD-1-1/7. All soil samples and rock cores are stored in the district Soils Laboratory.

(b) Drill Holes. - Holes were drilled in the overburden and rock with diamond core drilling equipment using 3½-inch casing in the overburden and 2-1/8inch bit to obtain rock cores. The overburden was dry samples using a 2-inch sampling tube at 34 of the holes. Soil samples were taken at approximately 5-foot intervals or at changes in material, and wash boring between samples was permitted. No overburden samples were taken at two holes. A total of 36 holes, including 3 at the entrance of the Point Rockway Canal, was drilled at the dam and wing dams with a total footage of 1,955.0 feet in overburden and 2371 feet in rock.

(c) Seismic Investigations. - Seismic investigations were conducted in the vicinity of the dam on both the Canadian and New York abutements to supplement the drill hole information for determining the location of bedrock. The method used was developed by E. R. Shepard, Senior Physicist, Office of the Chief of Engineers (for brief description, see article "The Seismic Method of Exploration Applied to Construction Projects" by E. R. Shepard, the Military Engineer, September - October 1939). A total of 18 seismic lines was fired in the vicinity of the dam site.

12-03. EXPLORATION OF MATERIALS FOR EMBANKMENTS AND CONCRETE AGGREGATES.

(a) Earth Fill. - Test pits, test trenches, and auger holes were excavated and sampled adjacent to the site to locate suitable borrow material for the earth embankments and cofferdams. The test pits were excavated to a depth of approximately 6 feet and, whenever possible, auger boring was extended below this depth. In general, bag and jar samples and photographs were taken. A total of 13 test pits and 3 test trenches was excavated. Besides test pitting and trenching, 4 holes were augered. On the basis of the information obtained from the test pit exploration and general geological reconnaissance, the borrow areas shown on contract drawing QD-1-20/2 were selected. Prior to construction, additional exploration should be completed to determine definitely the suitability of the materials in these areas. Suitable earth materials may also be obtained from the excavations for the dam and Point Rockway Canal as determined by the explorations for the design of these structures.

(b) Rock Fill and Riprap. - No additional exploration for material for rock fill and riprap was required other than that for the design of the dam and Point Rockway Canal. Suitable and a sufficient quantity of rock may be obtained from the excavation for the dam and canal.

(c) Bank Run Sand and Gravel. - The exploration to locate suitable materials for the sand and gravel backing for the embankments and road gravel was made in connection with the exploration for concrete aggregates. There are, in the vicinity, several small deposits of sand and gravel from which suitable material can be obtained. Some suitable material may be obtained from the excavation for the dam.

(d) Concrete Aggregates. - Exploration to locate suitable sources of concrete aggregates are being conducted. It is planned that the explorations will be completed so that information will be available prior to letting of the contract. Many deposits of sand and gravel within a radius of 25 miles of the site have been sampled and representative samples have been tested in the Central Concrete Laboratory, West Point, New York, to determine the suitability of the materials for concrete aggregates. All rock quarries in the vicinity have been sampled and the materials tested in Central Concrete Laboratory. Tests are being made to determine if the rock excavation in the Point Rockway Canal is satisfactory for aggregate. Studies are being made to determine if suitable stone sand can be produced from local rock for fine concrete aggregate. Natural deposits of sand or sand and gravel are being explored which are outside of a 25-mile radius and are near a railroad or near the St. Lawrence River.

12-04. METHOD AND EXTENT OF FIELD TESTS. - During the current investigation, the bedrock was pressure tested at 15 drill holes in the vicinity of the dam site. The tests were made using standard pressure pumping equipment. The data of the tests were recorded on the drill hole field logs which are on file in the District Office and the results of the tests are shown graphically on Plate XIII-1.

## 12-05. METHOD AND EXTENT OF LABORATORY TESTS AND INVESTIGATIONS.

(a) Soil Tests. - Due to the type of overburden materials in the foundations, materials available for embankment, construction, and the size of the earth embankments, an extensive program of soil testing was not made. All soil samples were classified using the M.I.T. scale of classification and recorded in a final report of each hole. The grain size distributions of a sufficient number of samples were determined by the usual sieve and hydrometer methods to serve as a guide in the classification of all samples. General geological descriptions of the overburden in each drill hole were prepared after studying the laboratory classification and the field logs. Moisture contents on a few samples were determined. No specific gravity, natural density determinations, shear or permeability tests were made.

(b) Rock Tests. - No laboratory tests have been made to determine the shearing strength of the bedrock since by visual inspection it is known that the rock is suitable for the stresses to be imposed. The bedrock is sound and durable and other tests are not required.

# SECTION XIII

## DESIGN OF EMBANKMENTS AND FOUNDATION FOR THE DAM

13-01. GENERAL. - The design of the embankments and dam foundation involved a study of the foundation conditions and characteristics, a study of the characteristics of the available embankment materials, the choice of a section which will utilize economically the available embankment materials and will be safe under any conditions. The methods of extent of the investigations to determine the characteristics of the foundation and embankment materials have been described in Section XII. This section includes a description of the results of those investigations which are pertinent to the design, a discussion of the choice, economy, and design of the embankments, and a discussion of the foundation treatment for the dam. The design of the cofferdam is described in Section XI.

### 13-02. GEOLOGICAL FEATURES AND CHARACTERISTICS OF FOUNDATION MATERIALS.

(a) Description of Site. - The dam site is located across the St. Lawrence River and extends from Iroquois Point in Canada to the New York mainland near Point Rockway as shown on Plate XII-I. There are no bedrock outcrops at the site, and the river is entirely controlled by glacial drift. The bedrock in general slopes to the northwest into an apparent pre-glacial channel which crosses the centerline of the dam near the left abutment. The overburden in the abutments and upstream from the centerline near the right abutment is compact glacial till which may be underlain by sand and gravel lying on the bedrock. Other sections of the river valley are filled with variable deposits varying from silty sand, gravel and boulders to previous gravelly sand. These deposits are probably washed material dropped from ice into standing water. A boulder pavement with same sand and gravel beds it believed to occur on the river bed.

(b) Bedrock.

(1) The bedrock at the site as shown by cores recovered from drilling consists of dolomite with a few insignificant thin beds of shale, sandstone and limestone. This rock is part of the Beekmantown formation which is lower Ordovician in age. Tentative correlation of the strata from drill cores shows that the bedding is almost horizontal, conforming to the general, very gentle northerly dip of the strata in the region. Bedrock contours drawn from drilling and seismic data and from soundings prior to 1940 are shown in Plate XII-1.

(2) Several drill holes at the site encountered fault zones. D-1050, D-1053, D-1356, and D-1357 showed badly brecciated and slickensided zones in the rock. In D-1043, D-1159, and D-1290 and D-1296 some evidence of movement or badly broken zones in the rock were found. The first evidence of faulting at the site was discovered in D-1053 where the rock was badly brecciated and partly recemented. Plate XIII-2 shows a photograph of the rock core recovered from this hole. During the initial stages of exploration, the centerline of the dam was located near D-1053 so three holes, the positions of which are shown on Plate XII-1 and in detail at the top of contract drawing QD-1-1/4, were drilled to determine the attitude of the fault plane. Only one of these holes, D-1159, encountered any indications of movement in the rock. D-1509, however, drilled later from a float in the river, encountered a major fault zone. The other scattered holes which showed evidence of movement are near the right abutment. Thus the attitude of the fault or faults has not yet been clearly defined, and it is believed that the rock is fractured in irregular zones with smaller gash faults extending from the main plane of movement. There

are no indications from drilling that the fault zone crosses the present axis of the dam.

(3) Pressure pumping tests were conducted at 15 holes. Because of freezing weather conditions, the results of some of the tests are not considered entirely reliable. Using the most reliable data from the tests, the leakage in each hole below the given elevations was plotted and is shown graphically on Plate XIII-1. Although broken along bedding planes and joints, the rock over the entire site is generally sound and unweathered except in the vicinity of the faulted zones. In these zones the rock is shattered and in some cases badly crushed. A few recemented fault zones were encountered but the major brecciated areas are open and uncemented. Plates XIII-2 and XIII-3 are photographs of fault breccia from drill hole D-1053. Water under artesian pressure was encountered at several of the drill holes.

(c) Overburden. - The general overburden relations along the axis of the dam and 200' upstream and downstream from the dam are shown by the geological profiles on Plates XIII-4 and XIII-5. The overburden in both abutments and in the river channel upstream and along the cneterline near the right abutment is largely a compact glacial till composed of slightly clayey very silty and gravelly sand with scattered boulders. There is a superficial deposit of sandy silt on the right abutment. In the river channel near the left abutment, and downstream from the centerline, the overburden is largely variable, slightly silty to silty gravelly sand with numerous boulders. On the bedrock surface beneath the till and the variable silty gravelly sand are scattered deposits of uniform fine to medium sand. Although some of the overburden samples are believed to be unreliable because of washing during drilling, there is evidence that in the variable silty gravelly sand deposits near the left abutment there are relatively pervious zones or lenses composed of fairly loose, gravelly sand. Water under artisian pressure was encountered in these deposits at several locations. On the river bed are scattered deposits of boulders and gravelly, slightly silty sand. Typical grain size curves of the various materials are shown on Plates XIII-5, XIII-7, and XIII-8. The estimated coefficients of permeability of the materials are: for the gravelly sand 0.01 to 0.02 cm./sec. for the variable, slightly silty to silty gravelly sand 0.00001 to 0.001 cm./sec. The compact till in the abutments has a coefficient of approximately 0.0000001. The angle of internal friction of all overburden material is estimated to be greater than 35 degrees. The water contents determination of till samples indicates that the compact very silty till in the abutments has a unit weight greater than 130 pounds per cubic foot.

## 13-03. AVAILABILITY AND CHARACTERISTICS OF EMBANKMENT MATERIALS.

(a) General. - The materials for the embankments will be obtained from the structure excavation, from borrow areas, shown on contract drawing QD-1-20/2, and from gravel deposits selected by the contractor. The borrow areas for the earth fill section contain the most economical materials in the vicinity which are suitable for a safe design. The following paragraphs describe the characteristics of the deposits and materials to be utilized, as determined by the investigations described in Section XII, which influence the design of the wing dams and abutment embankments.

(b) Earth Fill. - The materials for the earth fill sections of the wing dams and abutments and for backfill will be obtained from the structure excavation and from the borrow areas. Prior to construction, the borrow areas will be thoroughly explored to determine the location of the most suitable material. The material within the areas shown is in excess of that required, to permit a selection. The material within these areas is in general a compact silty gravelly sand with scattered boulders and cobbles. Material that will be selected for the embankments from the borrow areas and from the structure excavation will be well graded silty, gravelly sand and of the material passing the ½" sieve, at least 30% by weight shall pass the No. 200 sieve. Typical grain size curves of the material that will be selected are shown on Plate XIII-9. Based on experience with similar material, it is estimated that the material will be compacted to a dry weight of 125 pounds by six passes of a sheepsfoot roller. It is estimated that the material when compacted will be slightly cohesive, will have an angle of internal friction greater than 35 degrees, and the average coefficient of permeability will be less than 0.00001 cm. per sec.

(c) Sand and Gravel. - Sand and gravel for the backing under the riprap will be obtained from sandy gravel deposits in the vicinity or from structure excavation if available. There are within 15 miles of the site small superficial deposits of sand and gravel containing material which is believed to be suitable.

(d) Riprap. - Material for riprap for the wing dams will be obtained from structure excavation and from embankment materials. The rock obtained from structure excavation will be composed mainly of sound dolomite.

13-04. TREATMENT OF DAM FOUNDATION. - The foundation for the concrete dam will be sound bedrock. All loose, weathered or badly fractured rock will be excavated to produce a suitable foundation. Prior to placing concrete, the foundation bedrock will be thoroughly explored. Present exploration indicates that no grouting will be necessary for consolidation of the bedrock. It is believed not necessary to grout to prevent seepage through the rock since the water head on the dam is small. If any faults cross the base of the dam, the zone will be thoroughly grouted and sealed.

13-05. WING DAM SECTIONS. - As the design progressed to its final stage, the sections shown on contract drawing QD-1-20/1 were developed. Initial sections were the same except for details of the riprap blankets. The top width of the sections were governed by the width necessary for the highway and future railroad. The earth fill will be compacted to produce a uniform heterogeneous material, free from voids. The earth fill will not be compacted excessively since a small amount of compaction will produce a material with the required characteristics. The essential features of the wing dam embankments will be as described in the following paragraphs.

(a) Impervious Features. - The embankments will contain an earth fill section of material having a small coefficient of permeability. (See paragraph 13-03(b)). The earth fill will be compacted with sheepsfoot rollers, the central section more thoroughly than the outer sections. The compacted earth fill will extend a few feet into the foundation overburden to provide a cut-off in the upper overburden materials. Compacted earth fill will encase a part of the bulkheads.

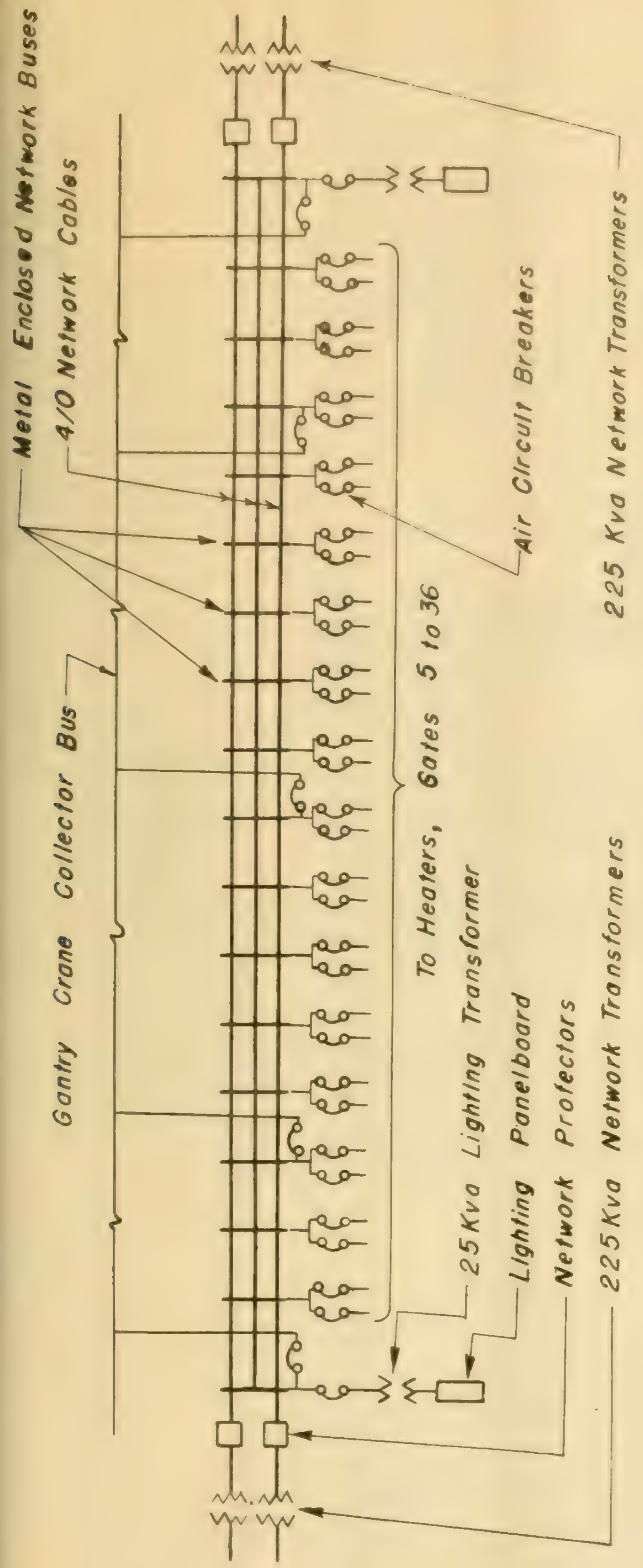
(b) Drainage Features. - As the normal differential head of water on the wing dams will be less than 5' and the maximum will be only 19', no special drainage features are proposed to control the small quantity of seepage through the embankments. Riprap placed on a layer of sand and gravel backing will protect the downstream slope from any possible erosion caused by the phreatic line emerging on the downstream slope.

(c) Slope Protection. - The slopes of the embankments will be protected against wave wash erosion by heavy riprap underlain by small rocks and sandy gravel. Slopes above elevation 254.5 will be protected with seeded topsoil.

13-06. BACKFILL AND ABUTMENT TREATMENT. - Backfill around the bulkheads will be compacted earth fill of material as described in paragraph 13-03(b). The materials will be obtained from the structure excavation or from borrow areas. The abutments will be excavated to the slopes shown on contract drawing QD-1-10/1. The slopes will be be protected with riprap. The riprap on the slopes upstream and downstream from the bulkheads will insure against erosion which may be caused by currents or wave wash.

13-07. ANALYSIS OF EMBANKMENT SECTION. - No mathematical analyses have been made of the embankment sections. Such analyses are believed to be unnecessary. Based on experience with similar materials and sections it is believed that the sections have ample safety for stability and that the quantity of seepage will be very small. Sufficient freeboard has been provided to compensate for any settlement which might occur.

13-08. ECONOMY OF CONSTRUCTION. - The embankments will be composed of suitable earth and rock materials from the structures excavations and from nearby borrow areas. Provisions have been made to utilize all of the stone and boulders from the earth fill material. Sand and gravel for the backing will have to be transported to the site. However, the design is such that the quantity of all materials not available at the site is a minimum.


Metal Enclosed Network Buses
4/0 Network Cables
Air Circuit Breakers
225 Kva Network Transformers
Gantry Crane Collector Bus
To Heaters, Gates 5 to 36
25 Kva Lighting Transformer
Lighting Panelboard
Network Protectors
225 Kva Network Transformers

ST. LAWRENCE RIVER PROJECT
IROQUOIS DAM
PLATE IX-1

U. S. ENGINEER OFFICE, MASSENA, N. Y.

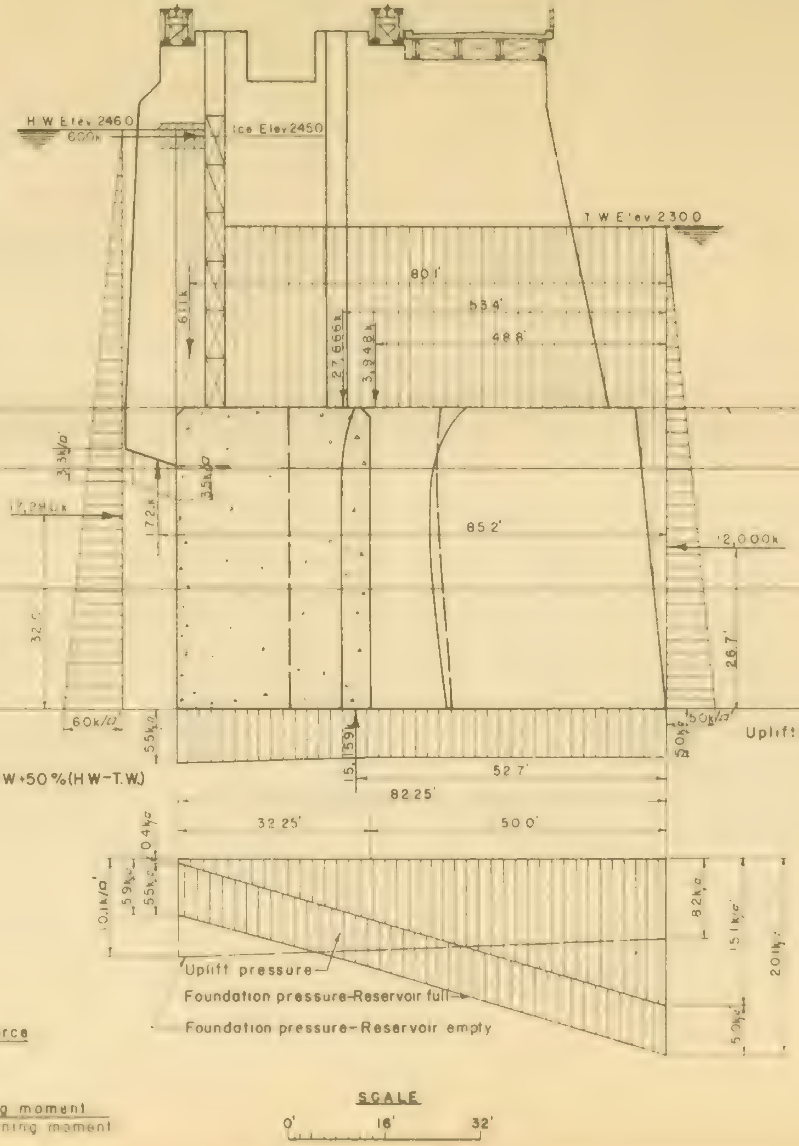
DR BY RMO
CH. BY

CONDITIONS: H. W. El. 246.0; T. W. El. 230.0; Ice 10k/ft at El 245.0, Uplift 100% T W + 50% (H W - T W)

| CONDITION OF RESERVOIR | | | |
|---|---|---|---|
| Full | Empty | | |
| $S_v$ | $S_v$ | Position of Resultant | |
| Lbs. Per Sq. In. | | | Elev |
| *-15. | 66. | 11.01 | 200 |
| 22. | 26. | 8.77 | 190 |
| 32. | 48. | 8.60 | 170 |
| 41. | 70. | 8.48 | 150 |

**STABILITY FACTORS**
Stresses At Upstream Face

* Minus sign indicates tension



| | CONDITION OF RESERVOIR | | | | | |
|---|---|---|---|---|---|---|
| | Full | | | | | Empty |
| | Position of Resultant | Sliding Factor | Mr / Mo | $S_v$ | $S_s$ | $S_v$ |
| Elev. | | | | Lbs. Per Sq In | | |
| 200 | ** -4.21 | 0.70 | 1.6 | 114. | 30. | 52. |
| 190 | 0.63 | 0.51 | 1.4 | 62. | 9. | 25. |
| 170 | 1.36 | 0.40 | 1.5 | 99. | 11. | 42. |
| 150 | 1.07 | 0.35 | 1.4 | 139. | 14. | 57. |

**STABILITY FACTORS**
Stresses At Downstream Face

* * Minus sign indicates that the resultant falls outside the Middle Third

**LEGEND**

Limits of Middle Third — — — — —
Position of Resultant ————

**NOTATION**

$S_v$ = Vertical stress

$S_s$ = Shear stress on horizontal plane = $\frac{\text{Horizontal force}}{\text{Area}}$

Sliding factor = $\frac{\text{Horizontal force}}{\text{Weight-Uplift}}$

$\frac{Mr}{Mo}$ - Safety factor against overturning $\frac{\text{Resisting moment}}{\text{Overturning moment}}$

ST LAWRENCE RIVER
# IROQUOIS DAM
ANALYSIS OF DESIGN
STABILITY ANALYSIS
60' PIER MONOLITH

Sketch No UD A-15

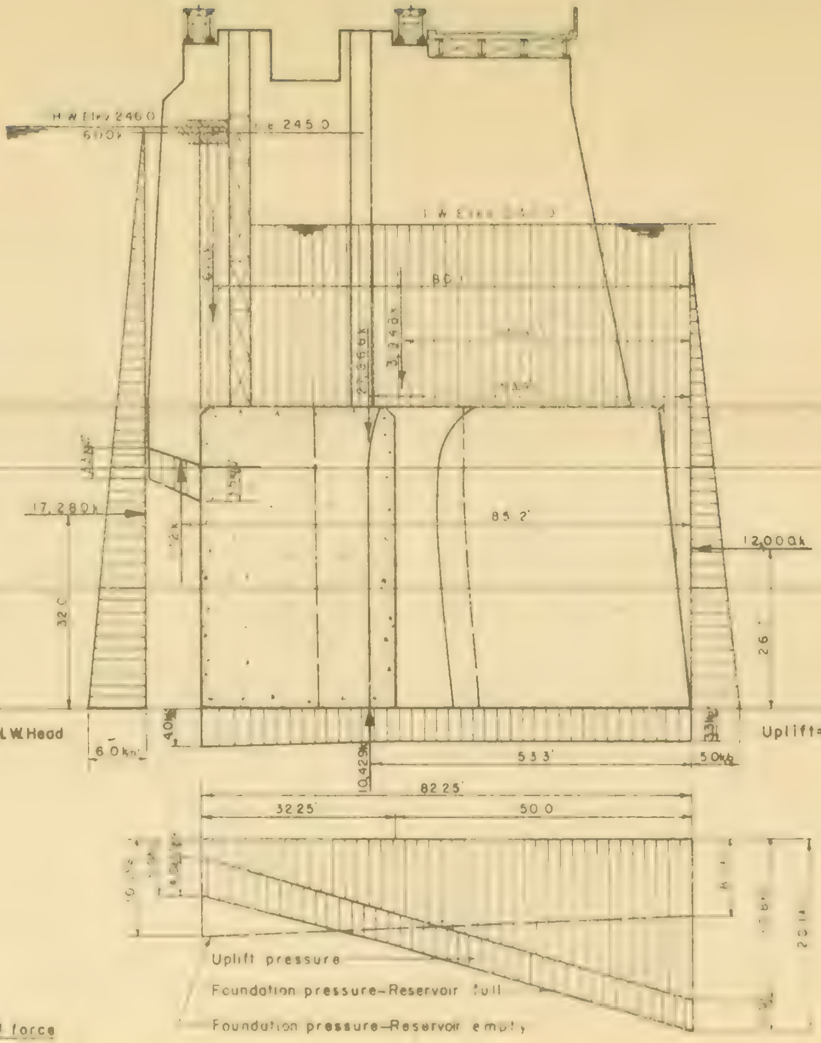
CONDITIONS H.W.El. 246.0, T.W.El. 230.0 Ice 10k/ft. at El. 245.0, Uplift 2/3 head

| CONDITION OF RESERVOIR | | | |
|---|---|---|---|
| Full | Empty | | |
| $S_v$ | $S_v$ | Position of Resultant | |
| Lbs. Per Sq. In. | | | Elev. |
| * -7 | 66 | 11.01 | 200 |
| 22 | 26 | 877 | 190 |
| 32 | 48 | 860 | 170 |
| 41 | 70 | 848 | 150 |

STABILITY FACTORS Uplift = $\frac{2}{3}$ H.W. Head

Stresses At Upstream Face

* Minus sign indicates tension



| | CONDITION OF RESERVOIR | | | | | |
|---|---|---|---|---|---|---|
| | Full | | | | | Empty |
| | Position of Resultant | Sliding Factor | Mr / Mo | $S_v$ | $S_s$ | $S_v$ |
| Elev. | | | | Lbs. Per Sq. In. | | |
| 200 | ** -.32 | 0.62 | 1.9 | 114 | 30 | [illegible] |
| 190 | 394 | 0.39 | 1.8 | [illegible] | 9 | [illegible] |
| 170 | 451 | 0.31 | 1.8 | 99 | 11 | 43 |
| 150 | 438 | 0.27 | 1.7 | 139 | 13 | 57 |

Uplift = $\frac{2}{3}$ T.W. Head

STABILITY FACTORS

Stresses At Downstream Face

** Minus sign indicates that the resultant falls outside the Middle Third

LEGEND

Limits of Middle Third ——

Position of Resultant ————

NOTATION

$S_v$ = Vertical stress

$S_s$ = Shear stress on horizontal plane = $\frac{\text{Horizontal force}}{\text{Area}}$

Sliding factor = $\frac{\text{Horizontal force}}{\text{Weight - Uplift}}$

$\frac{M_r}{M_o}$ = Safety factor against overturning = $\frac{\text{Resisting moment}}{\text{Overturning moment}}$

SCALE

0 15' 32'

ST. LAWRENCE RIVER

IROQUOIS DAM

ANALYSIS OF DESIGN

STABILITY ANALYSIS

[illegible]

[illegible] 204/52

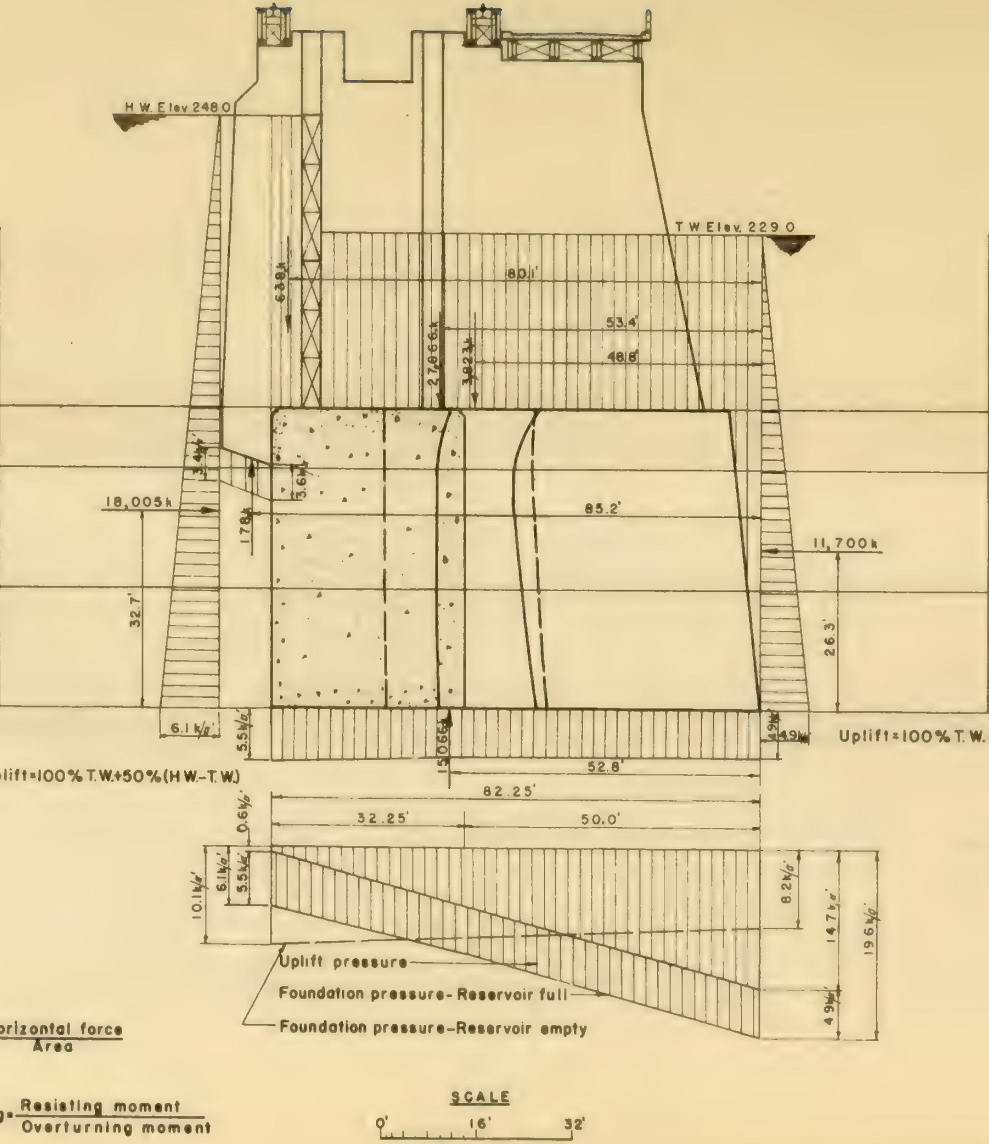
PLATE X-2

CONDITIONS: H.W. Elev. 248.0; T.W. El. 229.0; No ice; Uplift 100% T.W.+50%(H.W.-T.W.)

| CONDITION OF RESERVOIR | | | |
|---|---|---|---|
| Full | Empty | | |
| $S_v$ | $S_v$ | Position of Resultant | |
| Lbs. Per Sq. In. | | | Elev. |
| *-1. | 66. | 11.01 | 200 |
| 24. | 26. | 8.77 | 190 |
| 35. | 48. | 8.60 | 170 |
| 42. | 70. | 8.48 | 150 |

## STABILITY FACTORS
Stresses At Upstream Face

* Minus sign indicates tension



| | CONDITION OF RESERVOIR | | | | | |
|---|---|---|---|---|---|---|
| | Full | | | | | Empty |
| | Position of Resultant | Sliding Factor | Mr / Mo | $S_v$ | $S_s$ | $S_v$ |
| Elev. | | | | Lbs. Per Sq. In. | | |
| 200 | **-0.41 | 0.67 | 1.8 | 100. | 29. | 52. |
| 190 | 3.14 | 0.51 | 1.5 | 56. | 8. | 25. |
| 170 | 2.63 | 0.41 | 1.5 | 95. | 12. | 42. |
| 150 | 1.63 | 0.37 | 1.4 | 136. | 15. | 57. |

## STABILITY FACTORS
Stresses At Downstream Face

** Minus sign indicates that the resultant falls outside the Middle Third.

### LEGEND
Limits of Middle Third — — — —
Position of Resultant ————

### NOTATION
$S_v$ = Vertical stress

$S_s$ = Shear stress on horizontal plane = $\frac{\text{Horizontal force}}{\text{Area}}$

Sliding factor = $\frac{\text{Horizontal force}}{\text{Weight-Uplift}}$

$\frac{Mr}{Mo}$ = Safety factor against overturning = $\frac{\text{Resisting moment}}{\text{Overturning moment}}$

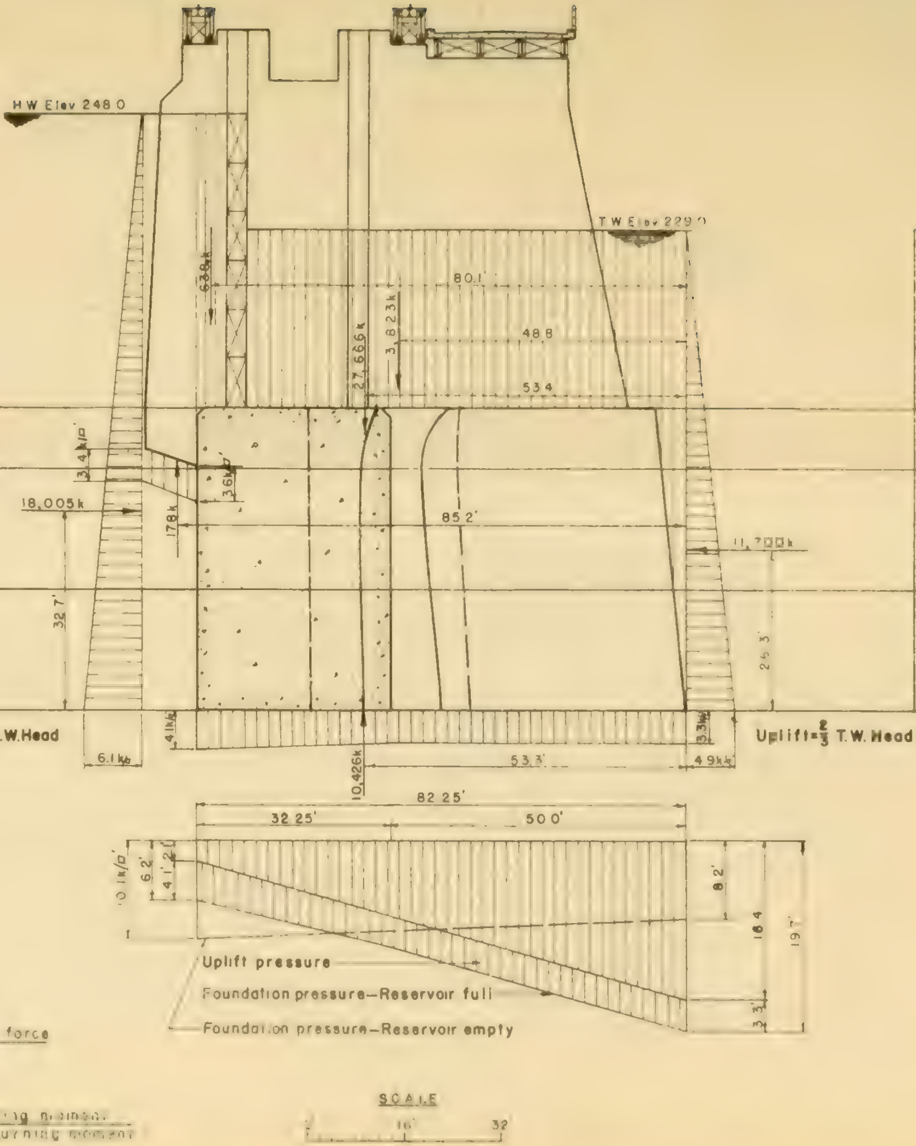
ST. LAWRENCE RIVER
# IROQUOIS DAM
ANALYSIS OF DESIGN
STABILITY ANALYSIS
60' PIER MONOLITH

Sketch No. QD-A-15/3

CONDITIONS H W Elev 248.0, T W El.229.0; No Ice; Uplift 2/3 head

| CONDITION OF RESERVOIR | | | |
|---|---|---|---|
| Full | Empty | | |
| $S_v$ | $S_v$ | Position of Resultant | Elev |
| Lbs. Per Sq. In. | | | |
| 20. | 66. | 11.01 | 200 |
| 24 | 26 | 877 | 190 |
| 35. | 48. | 86.0 | 170 |
| 42 | 70 | 848 | 150 |

**STABILITY FACTORS**
Stresses At Upstream Face



| | CONDITION OF RESERVOIR | | | | | |
|---|---|---|---|---|---|---|
| | Full | | | | | Empty |
| | Position of Resultant | Sliding Factor | Mr / Mo | $S_v$ | $S_s$ | $S_v$ |
| Elev | | | | Lbs Per Sq. In. | | |
| 200 | 156 | 059 | 22 | 39 | 29. | 52 |
| 190 | 56[illegible] | 039 | 18 | 56. | 8 | 25. |
| 170 | 540 | 032 | 1.8 | 95 | 12. | 4[illegible] |
| 150 | 473 | 029 | [illegible] | 136 | 15 | 57 |

**STABILITY FACTORS**
Stresses At Downstream Face

LEGEND
Limits of Middle Third — — — — —
Position of Resultant ————

NOTATION

$S_v$ = Vertical stress

$S_s$ = Shear stress on horizontal plane = $\frac{\text{Horizontal force}}{\text{Area}}$

Sliding factor = $\frac{\text{Horizontal force}}{\text{Weight Uplift}}$

$\frac{Mr}{Mo}$ - Safety factor against overturning = $\frac{\text{Resisting moment}}{\text{Overturning moment}}$

ST LAWRENCE RIVER
IROQUOIS DAM
ANALYSIS OF DESIGN
STABILITY ANALYSIS
60' [illegible]

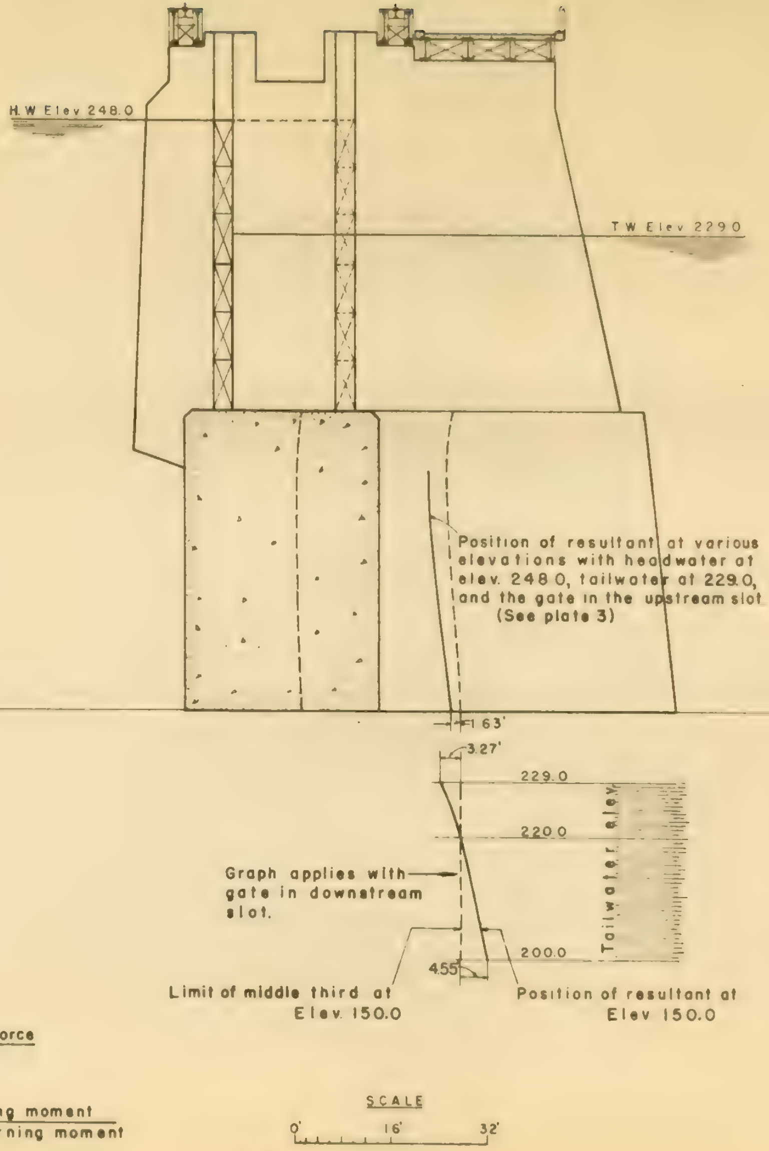
CONDITIONS H W Elev 248 0; T W drawn down from Elev 229 0; Gate in the downstream slot

NOTE

Data in tables applies to base elev 150.0 with headwater elev 248.0, tailwater elev 229.0 and gate in upstream slot (Uplift assumption is 100% T W and 50% (H W-T W) See plate 3)

Graph below applies to base elev 150.0 with headwater elev 248.0 and tailwater drawn down from elev 229.0, with gate in working (downstream) slot

Note that tailwater drops to elev 220.0 before the resultant passes outside the middle third


H W Elev 248.0
T W Elev 229 0
Position of resultant at various elevations with headwater at elev. 248 0, tailwater at 229.0, and the gate in the upstream slot (See plate 3)
1 63'
3.27'
229.0
220.0
200.0
Tailwater elev
4.55
Graph applies with gate in downstream slot.
Limit of middle third at Elev. 150.0
Position of resultant at Elev 150.0
SCALE
0'
16'
32'

| CONDITION OF RESERVOIR | | | |
|---|---|---|---|
| Full | Empty | | |
| $S_v$ | $S_v$ | Position of | |
| Lbs Per Sq In. | | Resultant | Elev. |
| 42. | 70. | 8.48 | 150 |

STABILITY FACTORS
Stresses At Upstream Face

| | CONDITION OF RESERVOIR | | | | | |
|---|---|---|---|---|---|---|
| | | Full | | | | Empty |
| | Position of | Sliding | Mr / Mo | $S_v$ | $S_s$ | $S_v$ |
| Elev. | Resultant | Factor | | Lbs Per Sq In | | |
| 150 | 1.63 | 0.37 | 1.4 | 136. | 15. | 57. |

STABILITY FACTORS
Stresses At Downstream Face

LEGEND

Limits of Middle Third — — — —
Position of Resultant ————

NOTATION

$S_v$ = Vertical stress

$S_s$ = Shear stress on horizontal plane = $\frac{\text{Horizontal force}}{\text{Area}}$

Sliding factor = $\frac{\text{Horizontal force}}{\text{Weight-Uplift}}$

$\frac{Mr}{Mo}$ = Safety factor against overturning = $\frac{\text{Resisting moment}}{\text{Overturning moment}}$

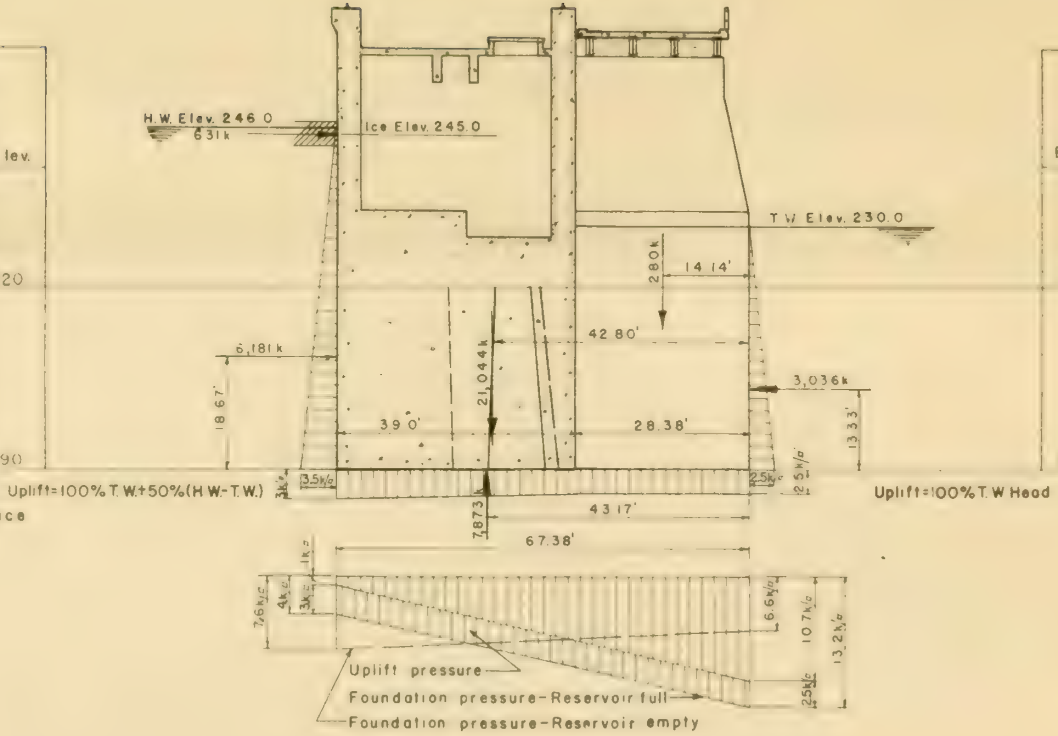
ST. LAWRENCE RIVER
# IROQUOIS DAM
ANALYSIS OF DESIGN
STABILITY ANALYSIS
60' PIER MONOLITH

Sketch No OD-A-15/5

CONDITIONS: H.W Elev 246.0; T.W 230.0, Ice 10k/ft at El 245.0, Uplift 100% T.W+50%(HW-TW)

| CONDITION OF RESERVOIR | | | |
|---|---|---|---|
| Full | Empty | | |
| $S_v$ | $S_v$ | Position of Resultant | Elev. |
| Lbs Per | Sq In | | |
| 11. | 18. | 6.71 | 220 |
| 28. | 53. | 583 | 190 |

**STABILITY FACTORS**
Stresses At Upstream Face



| | CONDITION OF RESERVOIR | | | | | |
|---|---|---|---|---|---|---|
| | Full | | | | | Empty |
| Elev | Position of Resultant | Sliding Factor | Mr / Mo | $S_v$ | $S_s$ | $S_v$ |
| | | | | Lbs | Per Sq | In |
| 220 | 2.38 | 0.29 | 2.6 | 42. | 5. | 27. |
| 190 | 2.44 | 0.28 | 1.9 | 92. | 9. | 46. |

**STABILITY FACTORS**
Stresses At Downstream Face

LEGEND

Limits of Middle Third — — — —
Position of Resultant ————

NOTATION

$S_v$ = Vertical stress
$S_s$ = Shear stress on horizontal plane = $\frac{\text{Horizontal force}}{\text{Area}}$
Sliding factor = $\frac{\text{Horizontal force}}{\text{Weight-Uplift}}$
$\frac{Mr}{Mo}$ = Safety factor against overturning = $\frac{\text{Resisting moment}}{\text{Overturning moment}}$

SCALE
0 16 32'

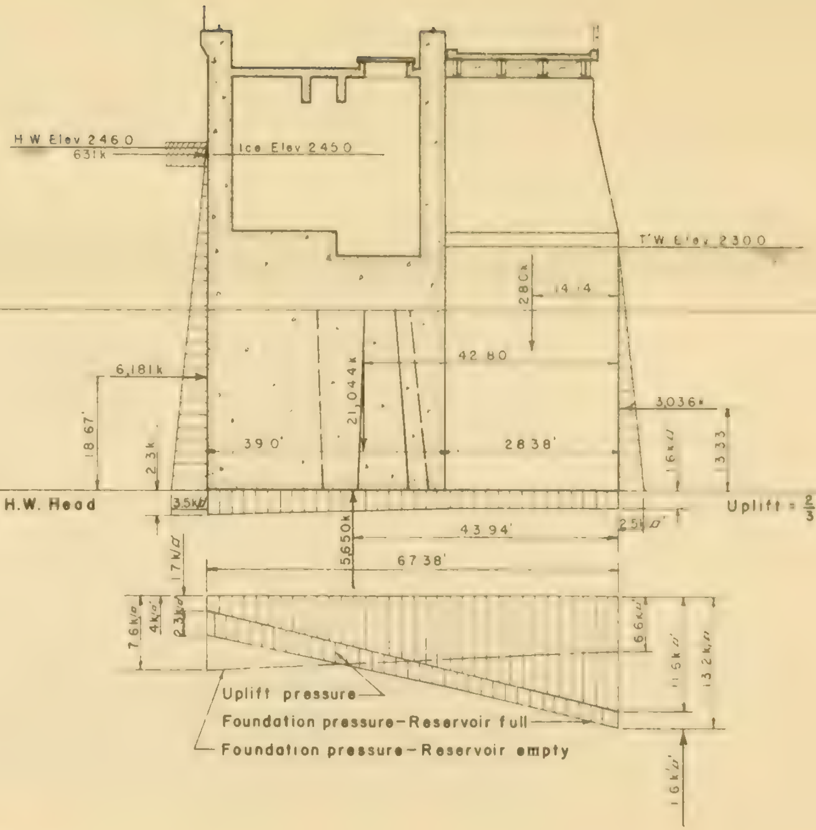
ST LAWRENCE RIVER
IROQUOIS DAM
ANALYSIS OF DESIGN
STABILITY ANALYSIS
EAST BULKHEAD
63' PIER MONOLITH

CONDITIONS: H.W. Elev 246.0; T.W. Elev 230.0; Ice-10k/ft at El 245.0; Uplift 2/3 head

| CONDITION OF RESERVOIR | | | | |
|---|---|---|---|---|
| Full | Empty | | | |
| $S_v$ | $S_v$ | Position of Resultant | Elev. |
| Lbs Per Sq. In. | | | |
| 11. | 18. | 6.71 | 220 |
| 28. | 53. | 5.83 | 190 |

Uplift = $\frac{2}{3}$ H.W. Head

### STABILITY FACTORS
Stresses At Upstream Face



Uplift = $\frac{2}{3}$ T.W. Head

| | CONDITION OF RESERVOIR | | | | | |
|---|---|---|---|---|---|---|
| | Full | | | | | Empty |
| Elev | Position of Resultant | Sliding Factor | $\frac{Mr}{Mo}$ | $S_v$ | $S_s$ | $S_v$ |
| | | | | Lbs Per Sq. In. | | |
| 220 | 2.49 | 0.28 | 3.0 | [illegible] | [illegible] | [illegible] |
| 190 | 3.48 | 0.34 | 2.4 | 92. | [illegible] | [illegible] |

### STABILITY FACTORS
Stresses At Downstream Face

LEGEND
Limits of Middle Third — — — —
Position of Resultant ————

NOTATION

$S_v$ = Vertical stress

$S_s$ = Shear stress on horizontal plane = $\frac{\text{Horizontal force}}{\text{Area}}$

Sliding factor = $\frac{\text{Horizontal force}}{\text{Weight-Uplift}}$

$\frac{Mr}{Mo}$ = Safety factor against overturning = $\frac{\text{Resisting moment}}{\text{Overturning moment}}$

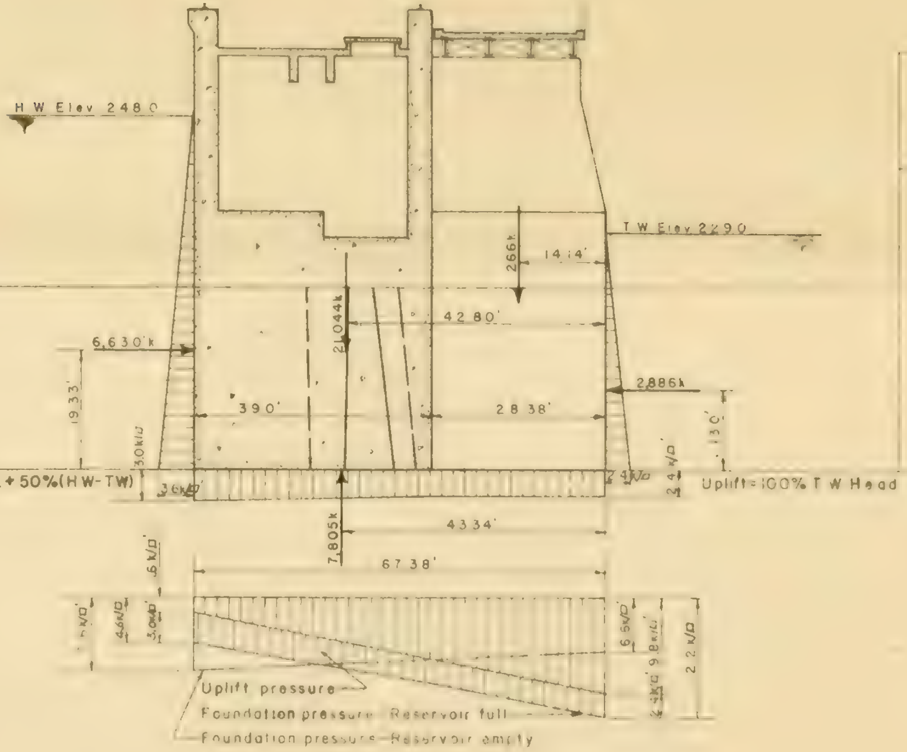
SCALE
0' 16' 32'

ST LAWRENCE RIVER
# IROQUOIS DAM
ANALYSIS OF DESIGN
STABILITY ANALYSIS
EAST BULKHEAD
63' PIER MONOLITH
Sketch No QD-A157

CONDITIONS: H.W. Elev. 248.0. T.W. Elev 229.0; No Ice; Uplift 100% T.W.+ 50% (H.W.-T.W.)

| CONDITION OF RESERVOIR | | | |
|---|---|---|---|
| Full | Empty | | |
| $S_v$ | $S_v$ | Position of Resultant | Elev. |
| Lbs. Per. Sq. In. | | | |
| 15. | 18. | 6.71 | 220 |
| 32. | 53. | 5.83 | 190 |

**STABILITY FACTORS**
Stresses At Upstream Face



| | CONDITION OF RESERVOIR | | | | | |
|---|---|---|---|---|---|---|
| | Full | | | | | Empty |
| Elev | Position of Resultant | Sliding Factor | Mr / Mo | $S_v$ | $S_s$ | $S_v$ |
| | | | | Lbs Per Sq. | | In |
| 220 | 4.51 | 0.25 | 2.9 | 35. | 4. | 17. |
| 190 | 3.6 | 0.16 | 2.0 | 85. | 9. | 46. |

**STABILITY FACTORS**
Stresses At Downstream Face

LEGEND

Limits of Middle Third — — — —
Position of Resultant ————

NOTATION

$S_v$ = Vertical stress
$S_s$ = Shear stress on horizontal plane = $\frac{\text{Horizontal force}}{\text{Area}}$
Sliding factor = $\frac{\text{Horizontal force}}{\text{Weight-Uplift}}$
$\frac{Mr}{Mo}$ = Safety factor against overturning = $\frac{\text{Resisting moment}}{\text{Overturning moment}}$

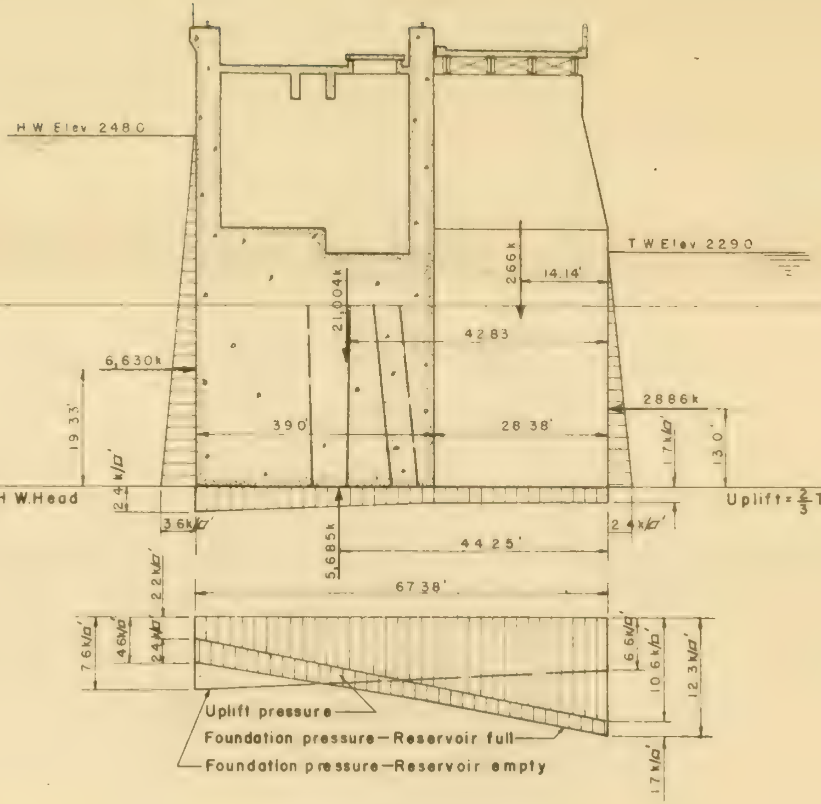
ST LAWRENCE RIVER
IROQUOIS DAM
ANALYSIS OF DESIGN
STABILITY ANALYSIS
EAST BULKHEAD
63' PIER MONOLITH

Section N 334.5 8

CONDITIONS: H.W. Elev 248.0, T.W. Elev 229.0, No Ice, Uplift: 2/3 head

| CONDITION OF RESERVOIR | | | |
|---|---|---|---|
| Full | Empty | | |
| $S_v$ | $S_v$ | Position of Resultant | Elev |
| Lbs. Per. Sq. In. | | | |
| 15. | 18. | 6.71 | 220 |
| 32. | 53. | 5.83 | 190 |

**STABILITY FACTORS**
Stresses At Upstream Face



| | CONDITION OF RESERVOIR | | | | | |
|---|---|---|---|---|---|---|
| | Full | | | | | Empty |
| Elev. | Position of Resultant | Sliding Factor | Mr / Mo | $S_v$ | $S_s$ | $S_v$ |
| | | | | Lbs. Per. Sq. In | | |
| 220 | 4.22 | 0.22 | 3.3 | 36. | 4. | 27. |
| 190 | 4.58 | 0.24 | 2.5 | 85. | 9. | 46. |

**STABILITY FACTORS**
Stresses At Downstream Face

**LEGEND**

Limits of Middle Third — — — —
Position of Resultant ————

**NOTATION**

$S_v$ = Vertical stress
$S_s$ = Shear stress on horizontal plane = $\frac{\text{Horizontal force}}{\text{Area}}$
Sliding factor = $\frac{\text{Horizontal force}}{\text{Weight-Uplift}}$
$\frac{Mr}{Mo}$ = Safety factor against overturning = $\frac{\text{Resisting moment}}{\text{Overturning moment}}$

SCALE
0' 16' 32'

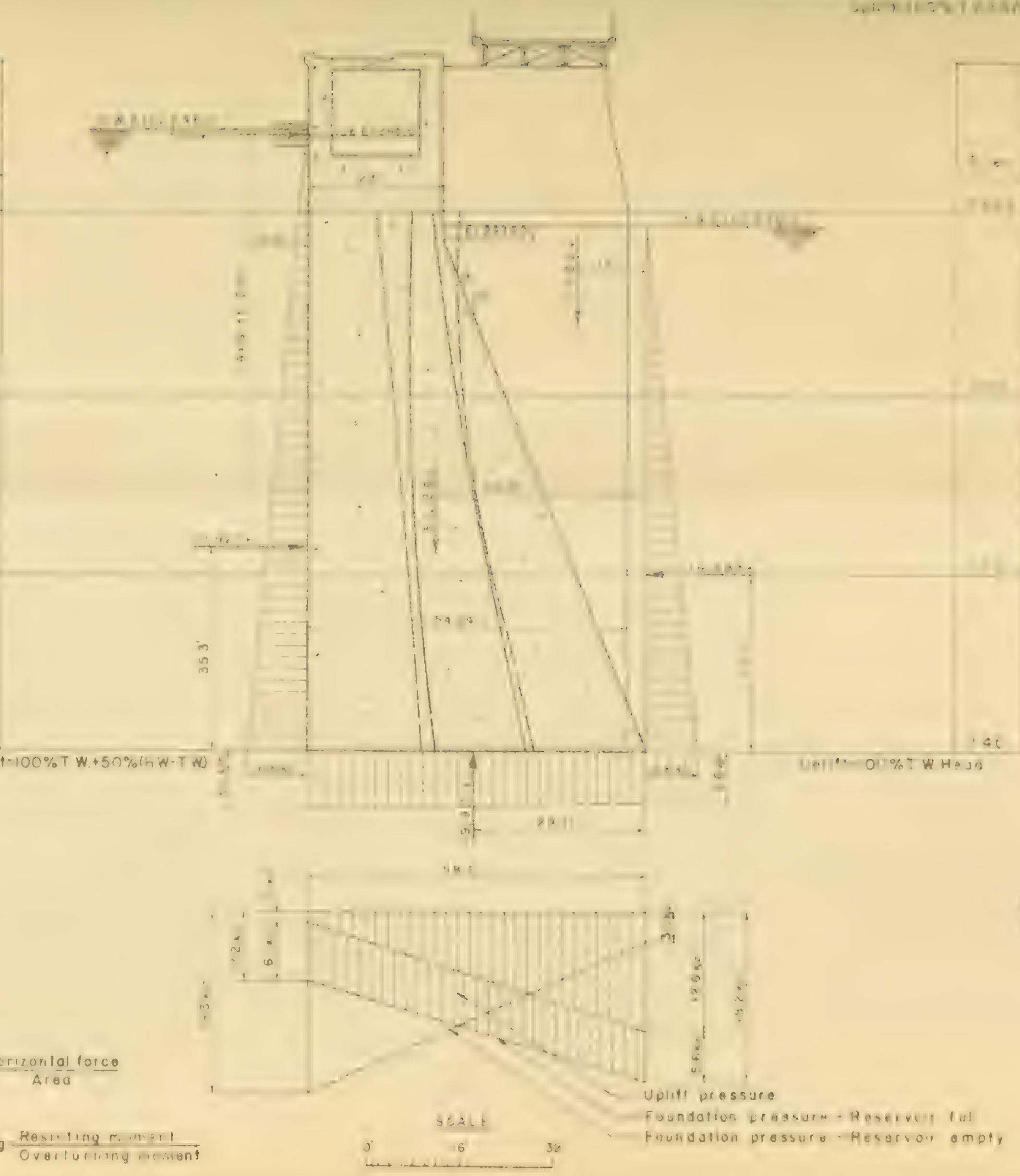
ST. LAWRENCE RIVER
# IROQUOIS DAM
ANALYSIS OF DESIGN
STABILITY ANALYSIS
EAST BULKHEAD
63' PIER MONOLITH

Sketch No CD-4159

[illegible]

| CONDITION OF RESERVOIR | | | | |
|---|---|---|---|---|
| Full | Empty | | | |
| $S_v$ | $S_v$ | Position of Resultant | Elev. |
| Lbs Per Sq In | | | |
| 11. | 14. | [illegible] | 232.5 |
| 27 | 50 | 26.6 | [illegible] |
| [illegible] | 93 | 17.6 | [illegible] |
| 50 | 133. | 26.9 | 140 |

STABILITY FACTORS
Stresses At Upstream Face



Uplift-100%T.W.+50%(H.W.-T.W.)
353'
Uplift-0%T.W. Head
Uplift pressure
Foundation pressure - Reservoir full
Foundation pressure - Reservoir empty
SCALE
0'
6
32

|  | CONDITION OF RESERVOIR | | | | | |
|---|---|---|---|---|---|---|
|  | Full | | | | | Empty |
| Elev. | Position of Resultant | Sliding Factor | Mr/Mo | $S_v$ | $S_s$ | $S_v$ |
|  |  |  |  | Lbs Per Sq In | | |
| [illegible] | [illegible] | 0.34 | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | 50 | [illegible] | [illegible] |
| [illegible] | [illegible] | 0.37 | [illegible] | [illegible] | [illegible] | [illegible] |
| 140 | [illegible] | 330 | 1.4 | 23 | 4. | [illegible] |

STABILITY FACTORS
Stresses At Downstream Face

LEGEND

Limits of Middle Third ————
Position of Resultant ————

NOTATION

$S_v$ = Vertical stress

$S_s$ = Shear stress on horizontal plane = $\frac{\text{Horizontal force}}{\text{Area}}$

Sliding factor = $\frac{\text{Horizontal force}}{\text{Weight-Uplift}}$

$\frac{Mr}{Mo}$ = Safety factor against overturning = $\frac{\text{Resisting moment}}{\text{Overturning moment}}$

ST. LAWRENCE RIVER
IROQUOIS DAM
ANALYSIS OF DESIGN
STABILITY ANALYSIS
WEST BULKHEAD
63 PIER MONOLITH

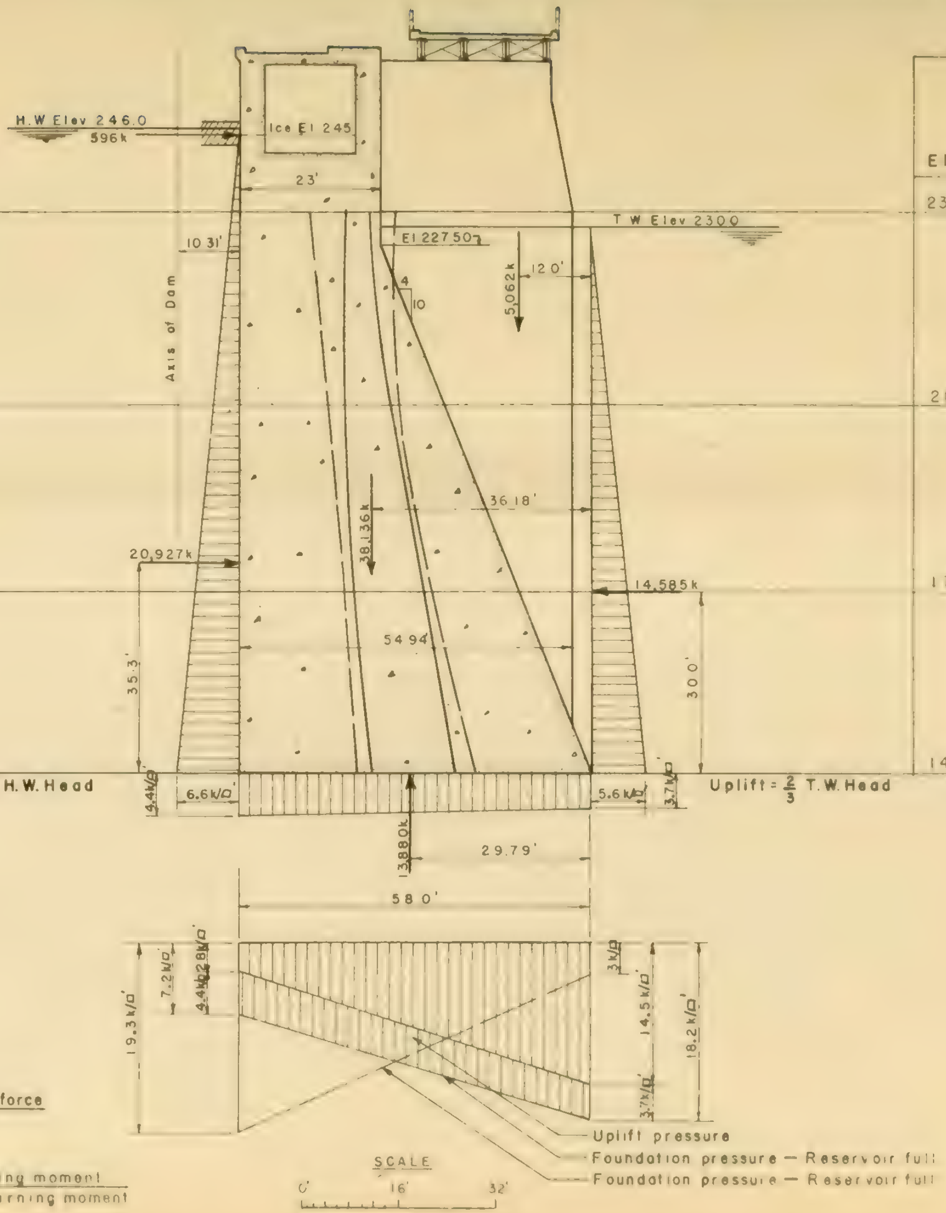
[illegible]

PLATE X-10

CONDITIONS: H.W. Elev. 246.0; T.W. Elev. 230.0; Ice: 10k/ft. at El. 245.0; Uplift 2/3 head

| CONDITION OF RESERVOIR | | | |
|---|---|---|---|
| Full | Empty | | |
| $S_v$ | $S_v$ | Position of Resultant | Elev. |
| Lbs. Per Sq. In. | | | |
| 11. | 14. | 6.46 | 232.5 |
| 20. | 50. | 2.56 | 200 |
| 31. | 93. | 1.76 | 170 |
| 50. | 134. | 2.60 | 140 |

**STABILITY FACTORS**
Stresses At Upstream Face



| | CONDITION OF RESERVOIR | | | | | |
|---|---|---|---|---|---|---|
| | Full | | | | | Empty |
| Elev. | Position of Resultant | Sliding Factor | Mr / Mo | $S_v$ | $S_s$ | $S_v$ |
| | | | | Lbs. Per Sq. In. | | |
| 232.5 | 4.36 | 0.25 | 5.9 | 42. | 4. | 30. |
| 200 | 1.56 | 0.28 | 2.4 | 30. | 9. | 26. |
| 170 | 1.53 | 0.26 | 1.8 | 114. | 12. | 16. |
| 140 | 3.33 | 0.24 | 1.6 | 127. | 4. | 21. |

**STABILITY FACTORS**
Stresses At Downstream Face

**LEGEND**

Limits of Middle Third — — — — —
Position of Resultant ————

**NOTATION**

$S_v$ = Vertical stress

$S_s$ = Shear stress on horizontal plane = $\frac{\text{Horizontal force}}{\text{Area}}$

Sliding factor = $\frac{\text{Horizontal force}}{\text{Weight-Uplift}}$

$\frac{Mr}{Mo}$ - Safety factor against overturning $\frac{\text{Resisting moment}}{\text{Overturning moment}}$

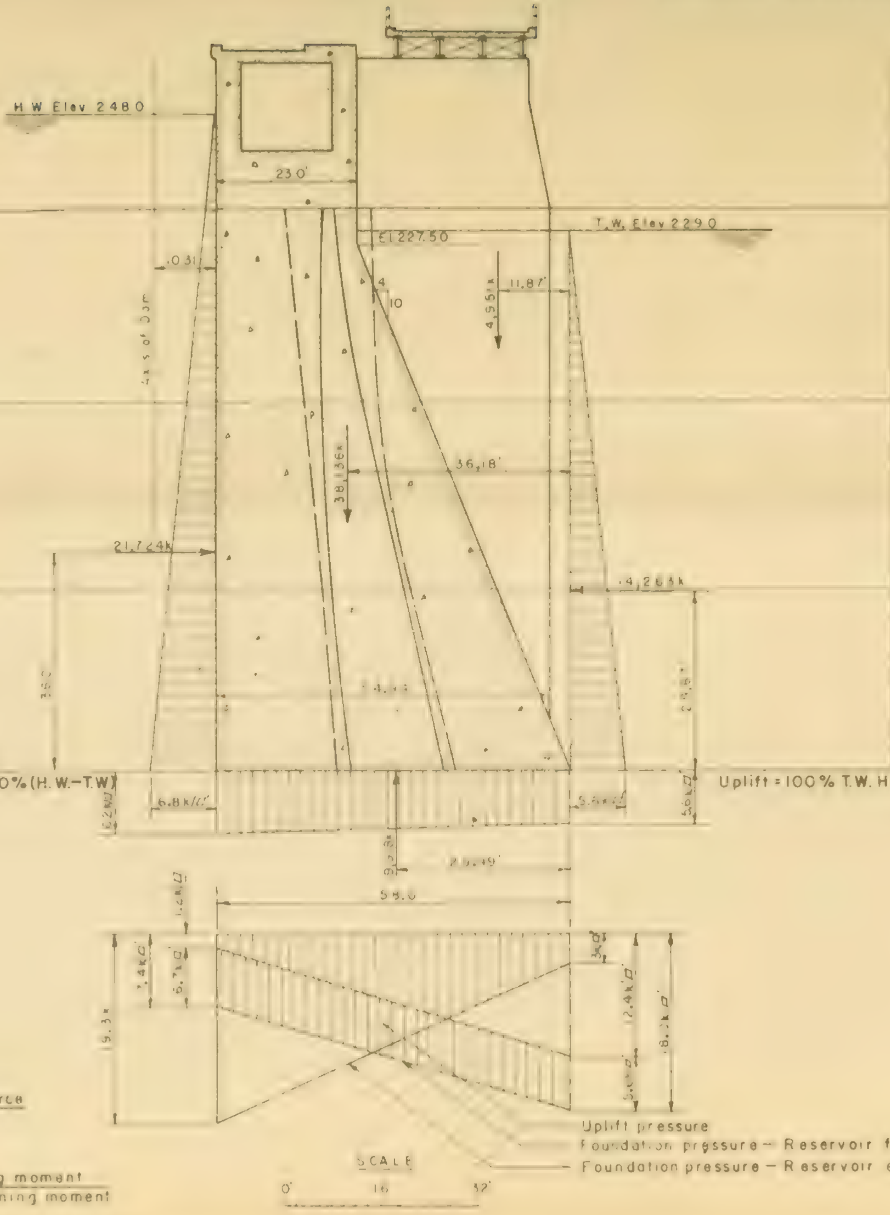
ST. LAWRENCE RIVER
IROQUOIS DAM
ANALYSIS OF DESIGN
STABILITY ANALYSIS
WEST BULKHEAD
60' PIER MONOLITH

CONDITIONS: H.W. Elev. 248.0; T.W. Elev. 229.0; No ice; Uplift: 100% + 50% (H.W. – T.W.)

| CONDITION OF RESERVOIR | | | |
|---|---|---|---|
| Full | Empty | | |
| $S_v$ | $S_v$ | Position of Resultant | Elev |
| Lbs Per Sq In. | | | |
| 14. | 14. | 6.46 | 232.5 |
| 27. | 50. | 2.56 | 200 |
| 36. | 93. | 1.76 | 170 |
| 52. | 134. | 2.60 | 140 |

Uplift = 100% T.W. + 50% (H.W. – T.W.)

STABILITY FACTORS
Stresses At Upstream Face



Uplift = 100% T.W. Head

Uplift pressure
Foundation pressure – Reservoir full
Foundation pressure – Reservoir empty

| | CONDITION OF RESERVOIR | | | | | |
|---|---|---|---|---|---|---|
| | Full | | | | | Empty |
| Elev. | Position of Resultant | Sliding Factor | Mr / Mo | $S_v$ | $S_s$ | $S_v$ |
| | | | | Lbs. Per Sq. In. | | |
| 232.5 | 6.29 | 0.12 | 9.0 | 34. | 2. | 30. |
| 200 | 2.73 | 0.35 | 2.2 | 77. | 9. | 26. |
| 170 | 1.30 | 0.33 | 1.6 | 101. | 13. | 18. |
| 140 | 1.37 | 0.32 | 1.4 | 125. | 15. | 21. |

STABILITY FACTORS
Stresses At Downstream Face

LEGEND
Limits of Middle Third — — — — —
Position of Resultant ————

NOTATION

$S_v$ = Vertical stress

$S_s$ = Shear stress on horizontal plane = $\frac{\text{Horizontal force}}{\text{Area}}$

Sliding factor = $\frac{\text{Horizontal force}}{\text{Weight-Uplift}}$

$\frac{Mr}{Mo}$ = Safety factor against overturning = $\frac{\text{Resisting moment}}{\text{Overturning moment}}$

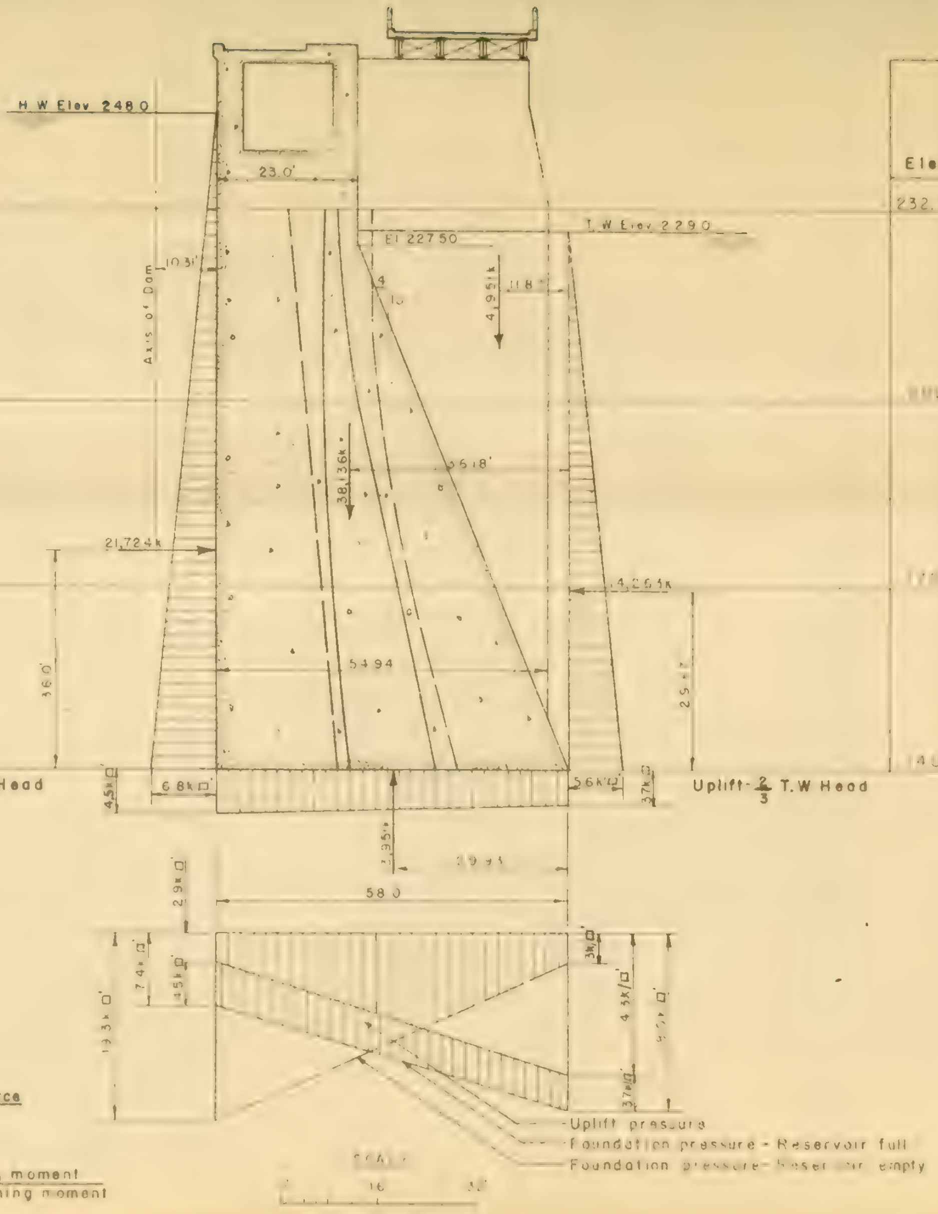
ST LAWRENCE RIVER
IROQUOIS DAM
ANALYSIS OF DESIGN
STABILITY ANALYSIS
WEST BULKHEAD
60' PIER MONOLITH

Sketch No 2DA-1912

CONDITIONS H.W. Elev 248.0, T.W. Elev 229.0; No Ice; Uplift 2/3 head

| CONDITION OF RESERVOIR | | | |
|---|---|---|---|
| Full | Empty | | |
| $S_v$ | $S_v$ | Position of Resultant | Elev. |
| Lbs. Per Sq. In. | | | |
| 14. | 14. | 6.46 | 232.5 |
| 27. | 50. | 2.56 | 200 |
| 36. | 93. | 1.76 | 170 |
| 52. | 134. | 2.60 | 140 |

STABILITY FACTORS
Stresses At Upstream Face



| Elev. | CONDITION OF RESERVOIR | | | | | |
|---|---|---|---|---|---|---|
| | Full | | | | | Empty |
| | Position of Resultant | Sliding Factor | Mr / Mo | $S_v$ | $S_s$ | $S_v$ |
| | | | | Lbs. Per Sq. In. | | |
| 232.5 | 5.95 | 0.12 | 7.2 | 34. | 2. | 30. |
| 200 | [illegible] | 0.27 | [illegible] | [illegible] | [illegible] | 26. |
| 170 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 14. |
| 140 | 3.45 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

STABILITY FACTORS
Stresses At Downstream Face

LEGEND

Limits of Middle Third ——————
Position of Resultant ——————

NOTATION

$S_v$ = Vertical stress

$S_s$ = Shear stress on horizontal plane = $\frac{\text{Horizontal force}}{\text{Area}}$

Sliding factor = $\frac{\text{Horizontal force}}{\text{Weight-Uplift}}$

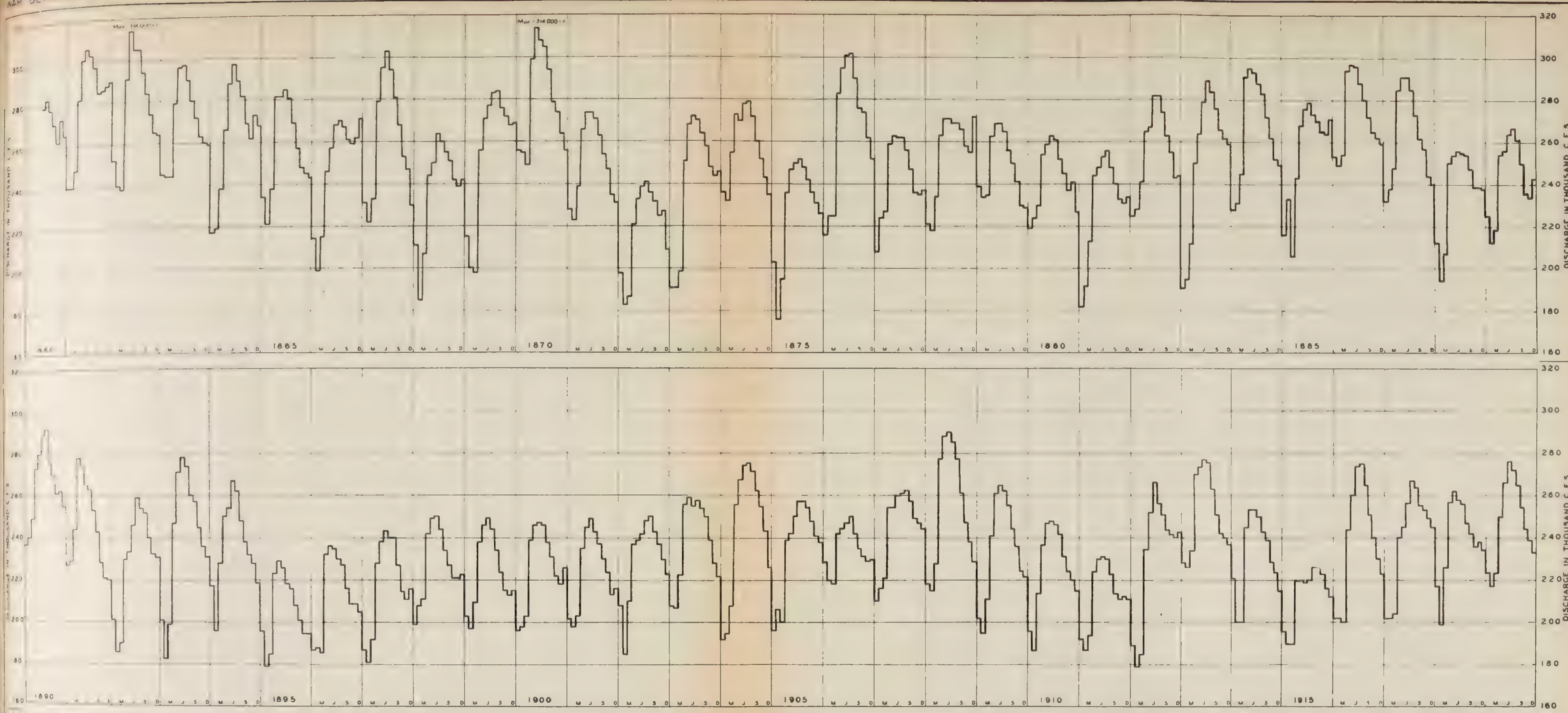
$\frac{M_r}{M_o}$ = Safety factor against overturning = $\frac{\text{Resisting moment}}{\text{Overturning moment}}$

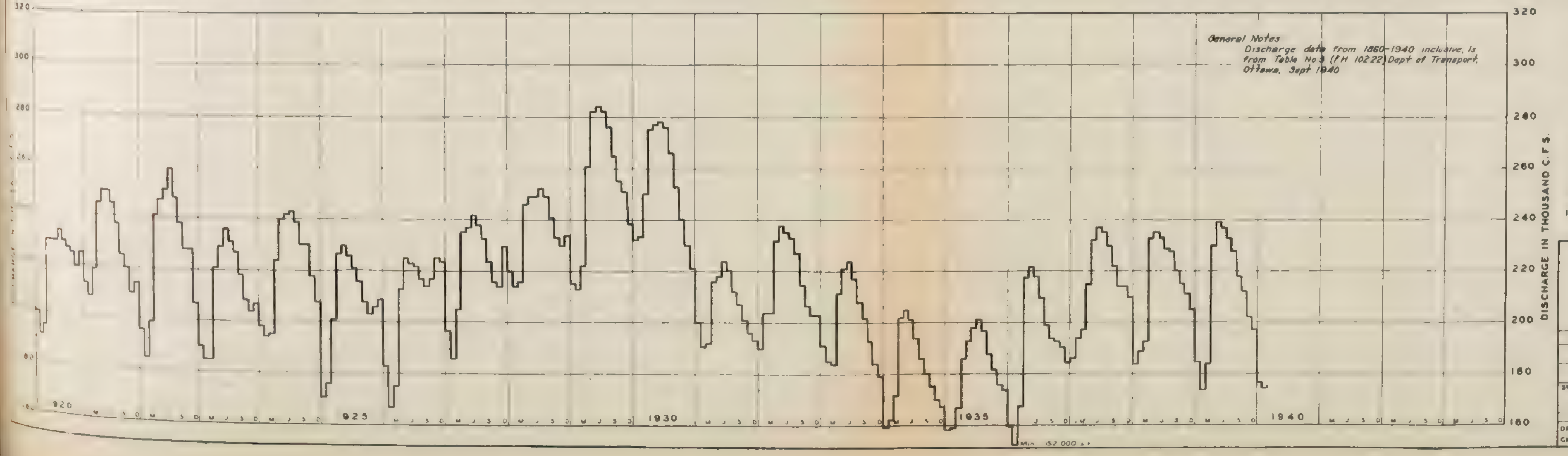
ST. LAWRENCE RIVER
IROQUOIS DAM
ANALYSIS OF DESIGN
STABILITY ANALYSIS
WEST BULKHEAD
[illegible]

PLATE X-13

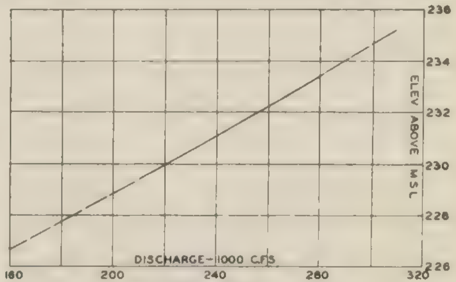
WAR DEPARTMENT

CORPS OF ENGINEERS, U.S.ARMY





*General Notes*
*Discharge data from 1860-1940 inclusive, is from Table No 3 (FH 10222) Dept of Transport, Ottawa, Sept 1940*



RATING CURVE
ST LAWRENCE RIVER AT IROQUOIS DAM SITE

ST LAWRENCE RIVER PROJECT

# MEAN MONTHLY DISCHARGES

## ST LAWRENCE RIVER

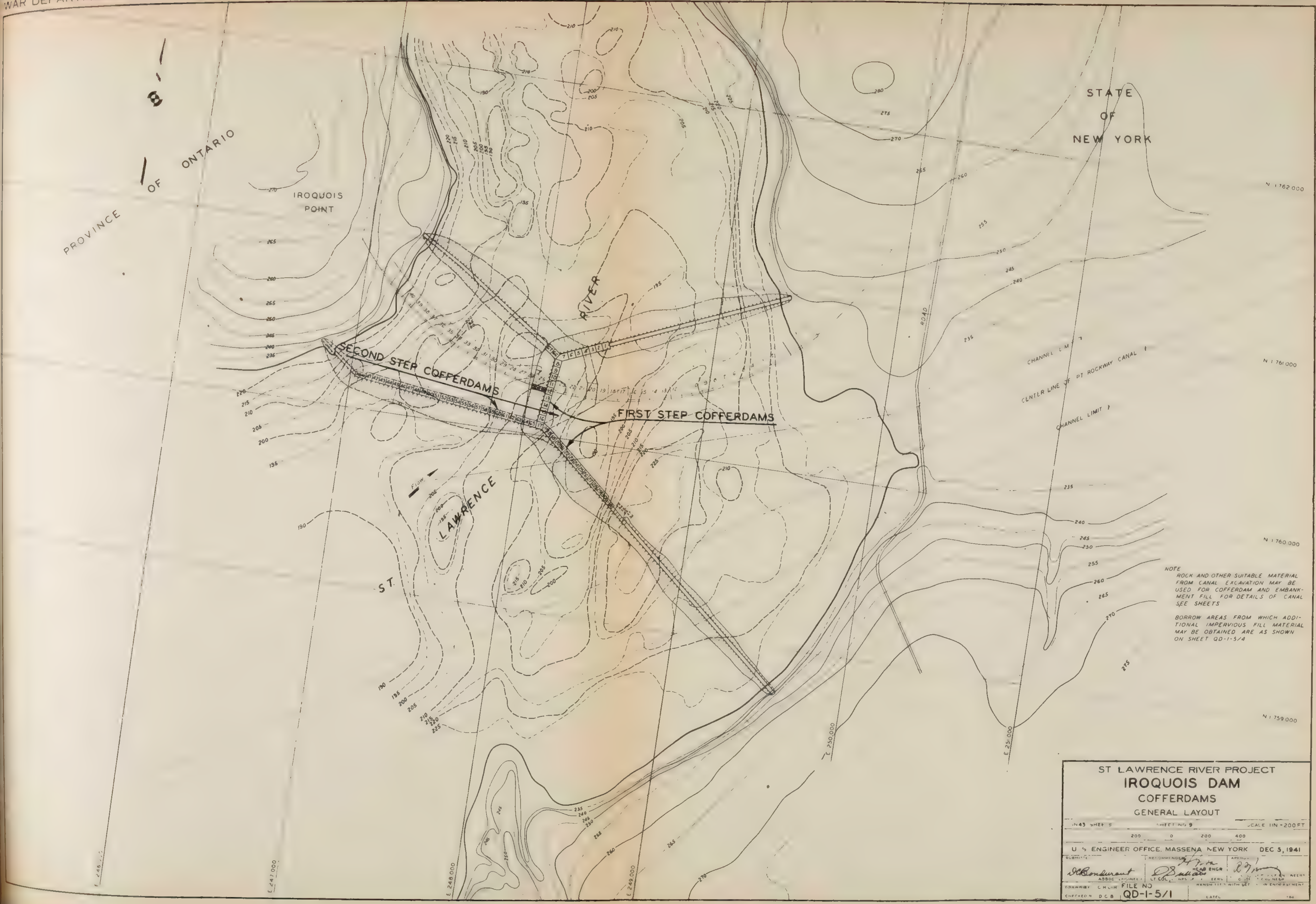
1860-1941

| | | |
|---|---|---|
| IN 43 SHEETS | SHEET NO 4 | SCALES SHOWN |

U S ENGINEER OFFICE, MASSENA, NEW YORK, DEC 12, 1941

| SUBMITTED | RECOMMENDED | APPROVED |
|---|---|---|
| D C Bondurant<br>ASSOC. ENGINEER | HEAD ENG<br>LT COL. CORPS OF ENGINEERS | COL. CORPS OF ENGINEERS<br>DISTRICT ENGINEER |

DRAWN BY R.L.F.
CHECKED BY D.C.B.
FILE NO. QD-1-1/3



NOTE
ROCK AND OTHER SUITABLE MATERIAL FROM CANAL EXCAVATION MAY BE USED FOR COFFERDAM AND EMBANKMENT FILL FOR DETAILS OF CANAL SEE SHEETS

BORROW AREAS FROM WHICH ADDITIONAL IMPERVIOUS FILL MATERIAL MAY BE OBTAINED ARE AS SHOWN ON SHEET QD-1-5/4

ST LAWRENCE RIVER PROJECT
**IROQUOIS DAM**
COFFERDAMS
GENERAL LAYOUT

IN 43 SHEETS SHEET NO 9 SCALE 1 IN = 200 FT

200 0 200 400

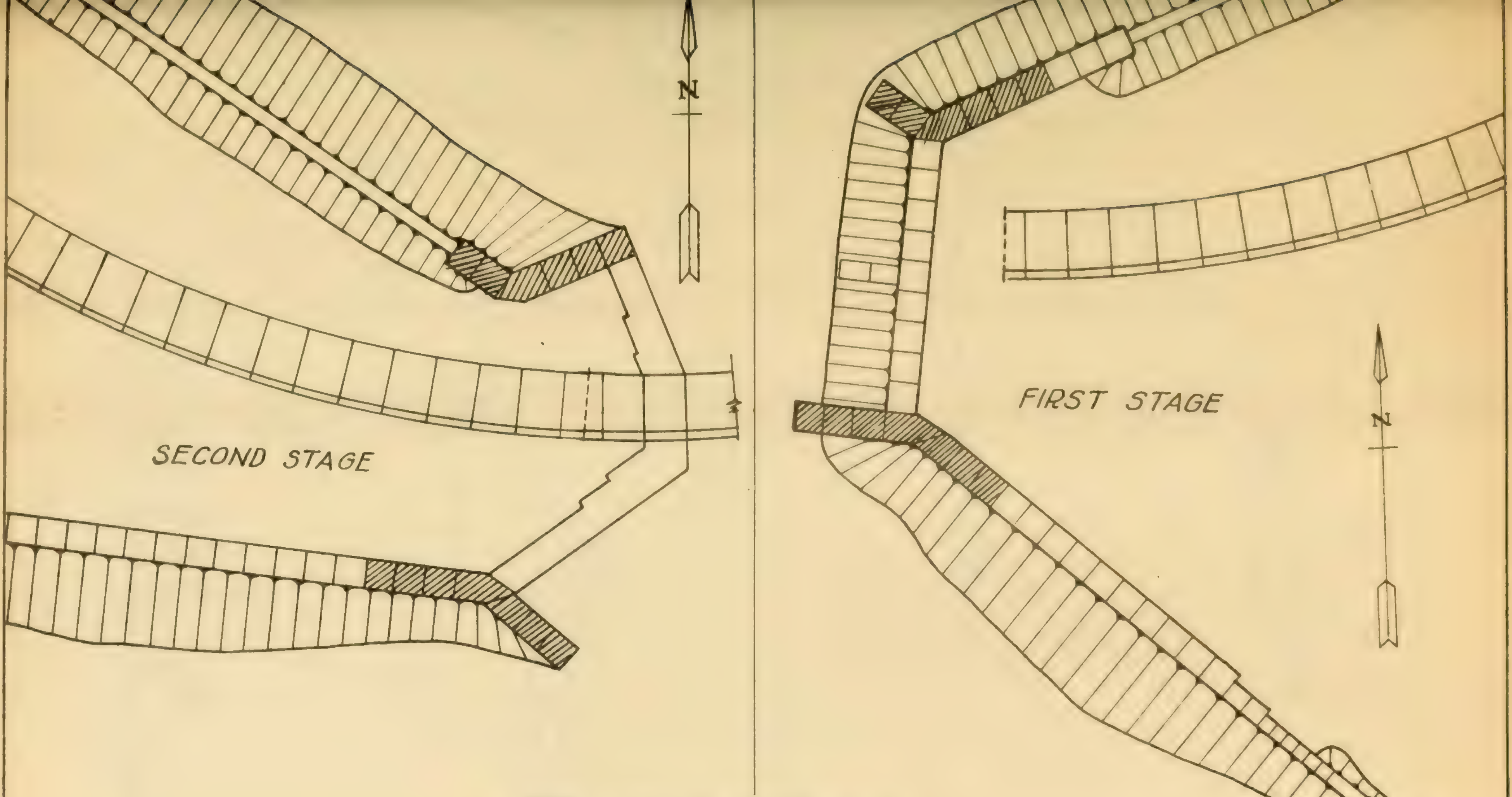
U S ENGINEER OFFICE, MASSENA NEW YORK DEC 5, 1941

SUBMITTED: ASSOC ENGINEER
RECOMMENDED: HEAD ENGR; LT COL, CORPS OF ENGINEERS
APPROVED: COLONEL, CORPS OF ENGINEERS, DIVISION ENGINEER

DRAWN BY C H C H
CHECKED BY D C B
FILE NO QD-1-5/1

TRANSMITTED WITH LET FOR ENDORSEMENT
DATED 194

PLATE XI-2

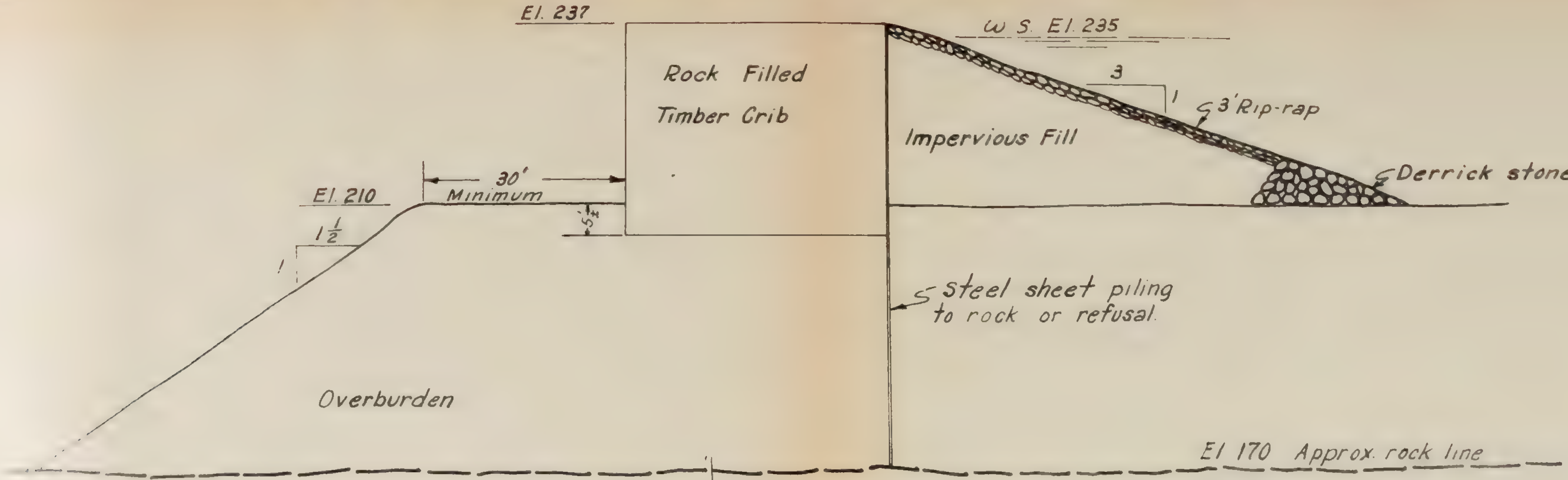


▨ Denotes common cribs.

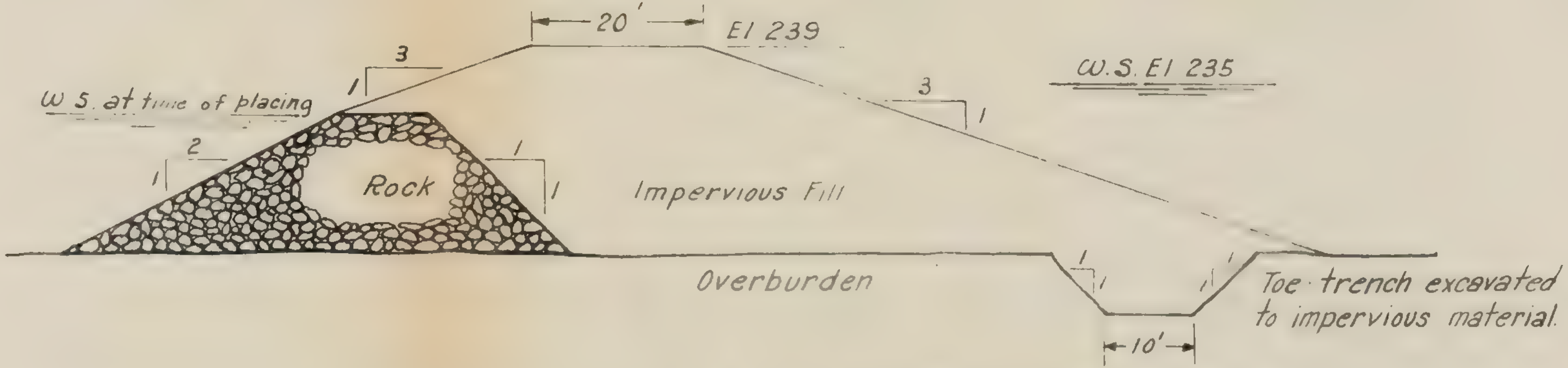
IROQUOIS DAM
COFFERDAMS
LAYOUT OF CONSTRUCTION STAGES
Scale: 1" = 200'

QD-A-5/1

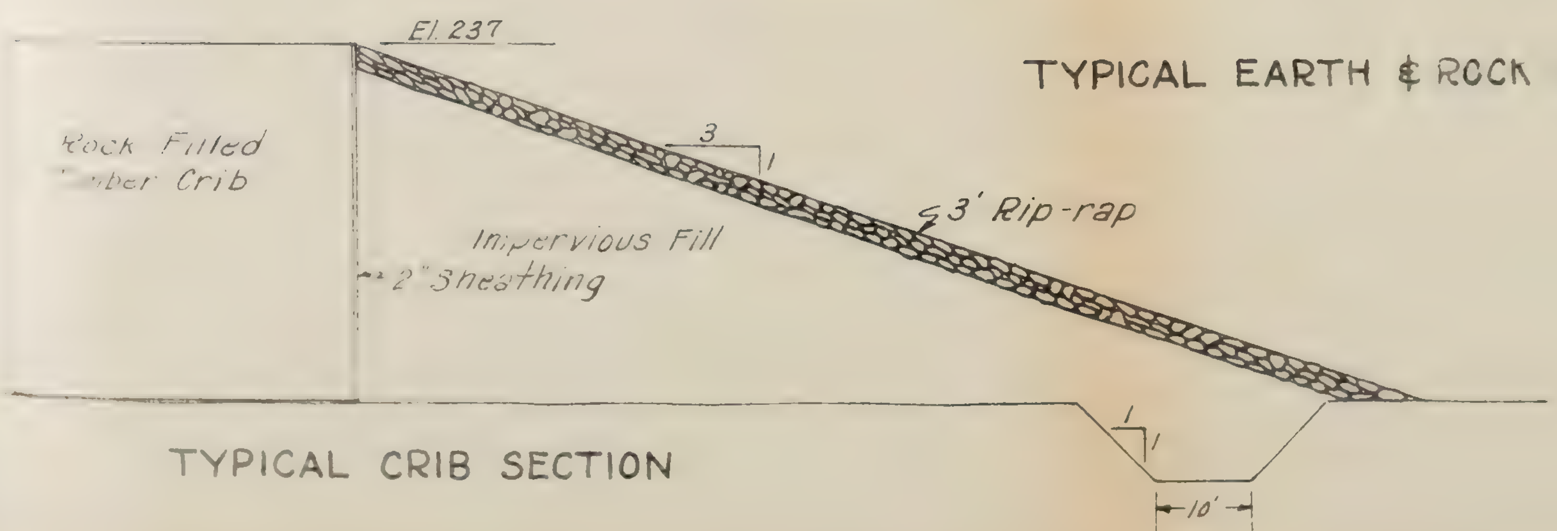
PLATE XI-3



TYPICAL SECTION — RIVER ARM OF 1ST STAGE COFFERDAM

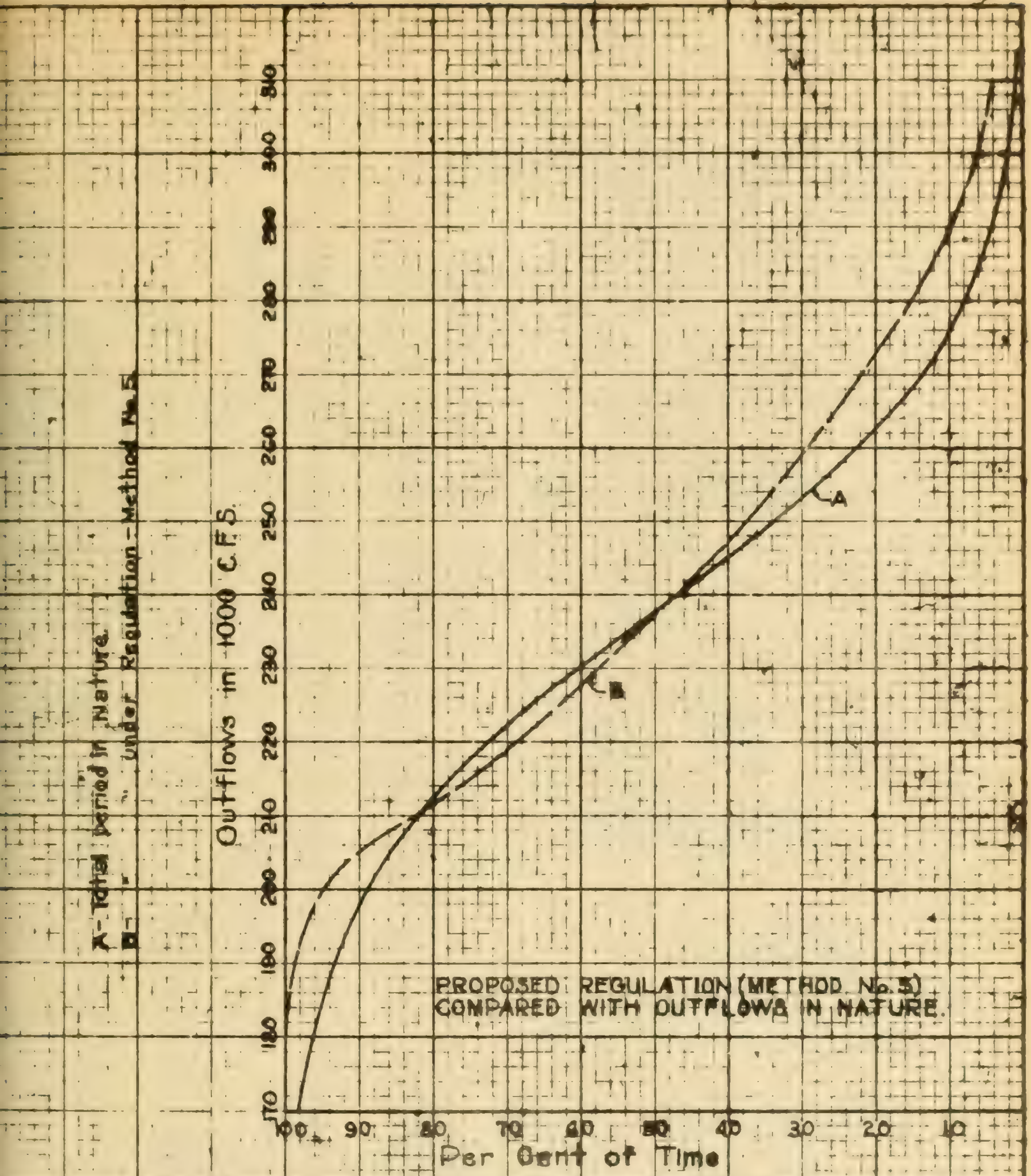


TYPICAL EARTH & ROCK EMBANKMENT SECTION



TYPICAL CRIB SECTION

IROQUOIS DAM
COFFERDAMS
TYPICAL COFFERDAM SECTIONS
Scale: 1" = 20'
QD-A-5/2



PROPOSED REGULATION (METHOD No.5) COMPARED WITH OUTFLOWS IN NATURE.

Note: Information plotted from
Dept. of Transport dw'g# 2183

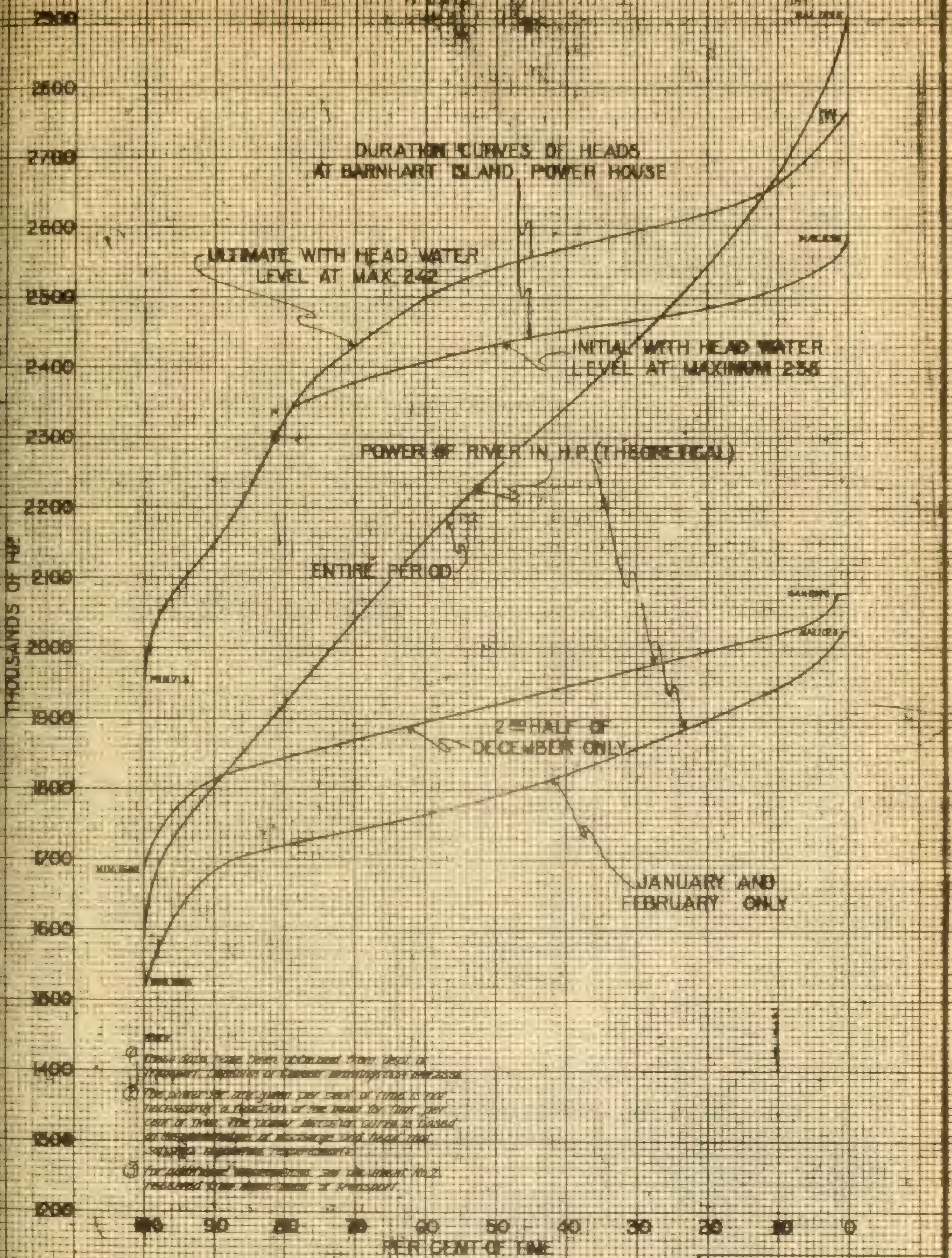
ST. LAWRENCE RIVER PROJECT
DISCHARGE DURATION CURVES
(ACTUAL AND REGULATED)

IN ONE SHEET SCALES AS SHOWN

U.S. ENGINEER OFFICE, MASSENA, N.Y. DEC. 1940.

Submitted: Approved:

DRAWN: CH.H
CKD: GD-A-99



NOTE:

① [illegible]

② The power for any given per cent of time is not necessarily a function of the head for that per cent of time. [illegible]

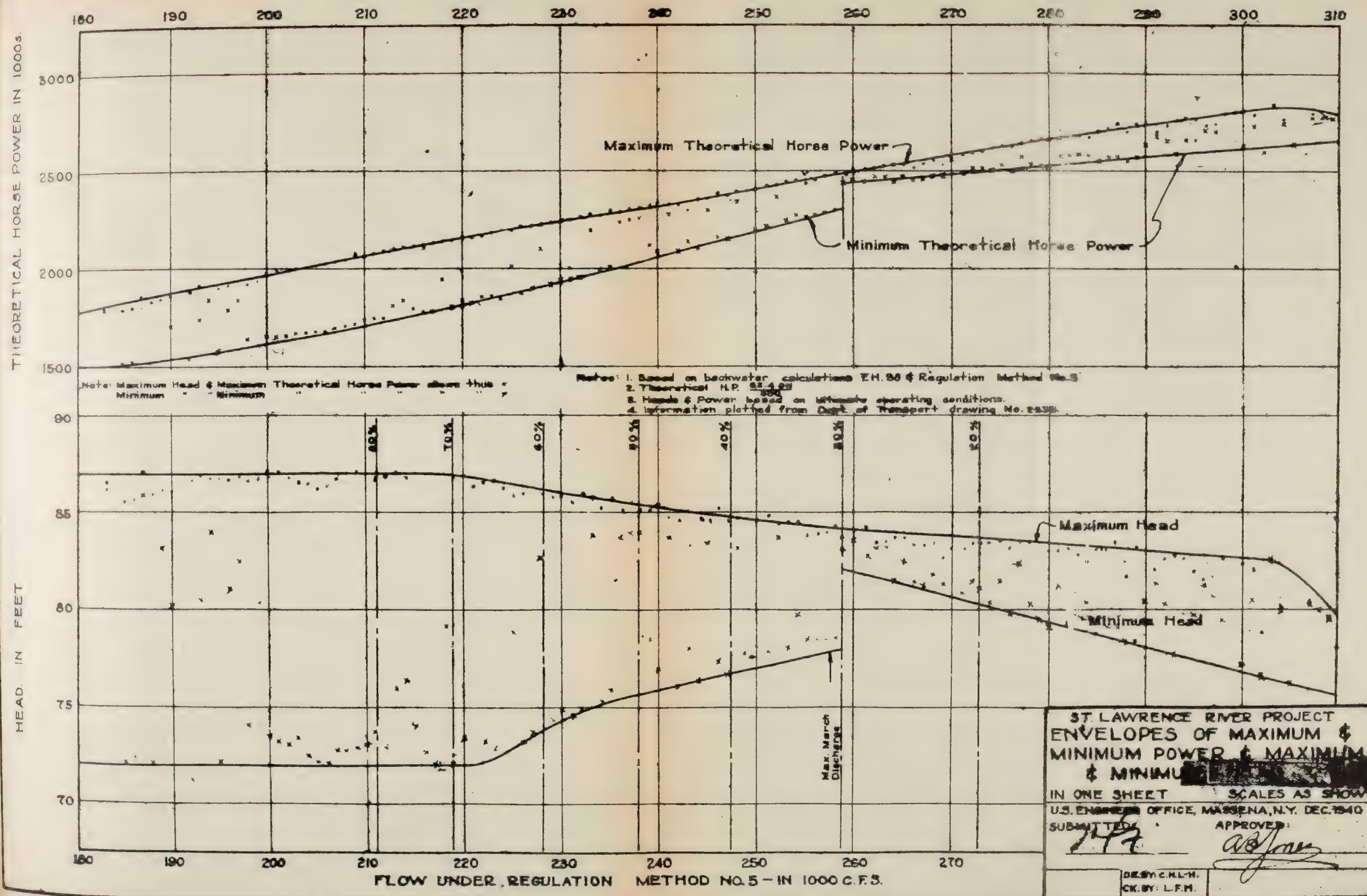
③ [illegible]

[illegible] RIVER PROJECT

POWER AND HEAD
DURATION CURVES

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



Note: Maximum Head & Maximum Theoretical Horse Power shown thus ·
Minimum " " Minimum " " " " " ×

Notes: 1. Based on backwater calculations T.H. 86 & Regulation Method No. 5
2. Theoretical H.P. $\frac{62.4\,QH}{550}$
3. Heads & Power based on ultimate operating conditions.
4. Information plotted from Dept. of Transport drawing No. 2838.

ST. LAWRENCE RIVER PROJECT
ENVELOPES OF MAXIMUM & MINIMUM POWER & MAXIMUM & MINIMU[redacted]
IN ONE SHEET SCALES AS SHOWN

U.S. ENGINEER OFFICE, MASSENA, N.Y. DEC. 1940

SUBMITTED:

APPROVED:
A.B. Jones

DR. BY: C.H.L-H.
CK. BY: L.F.H.

- PLATE XI-C

QD-A-11c

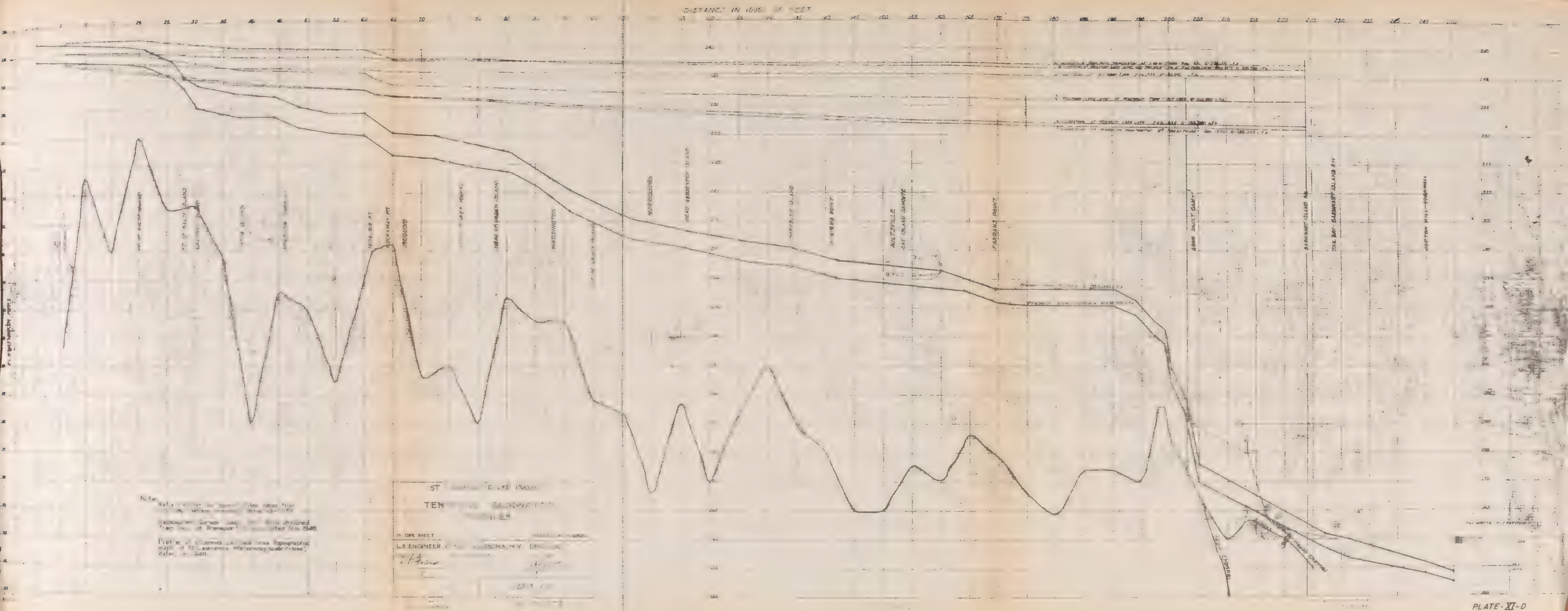
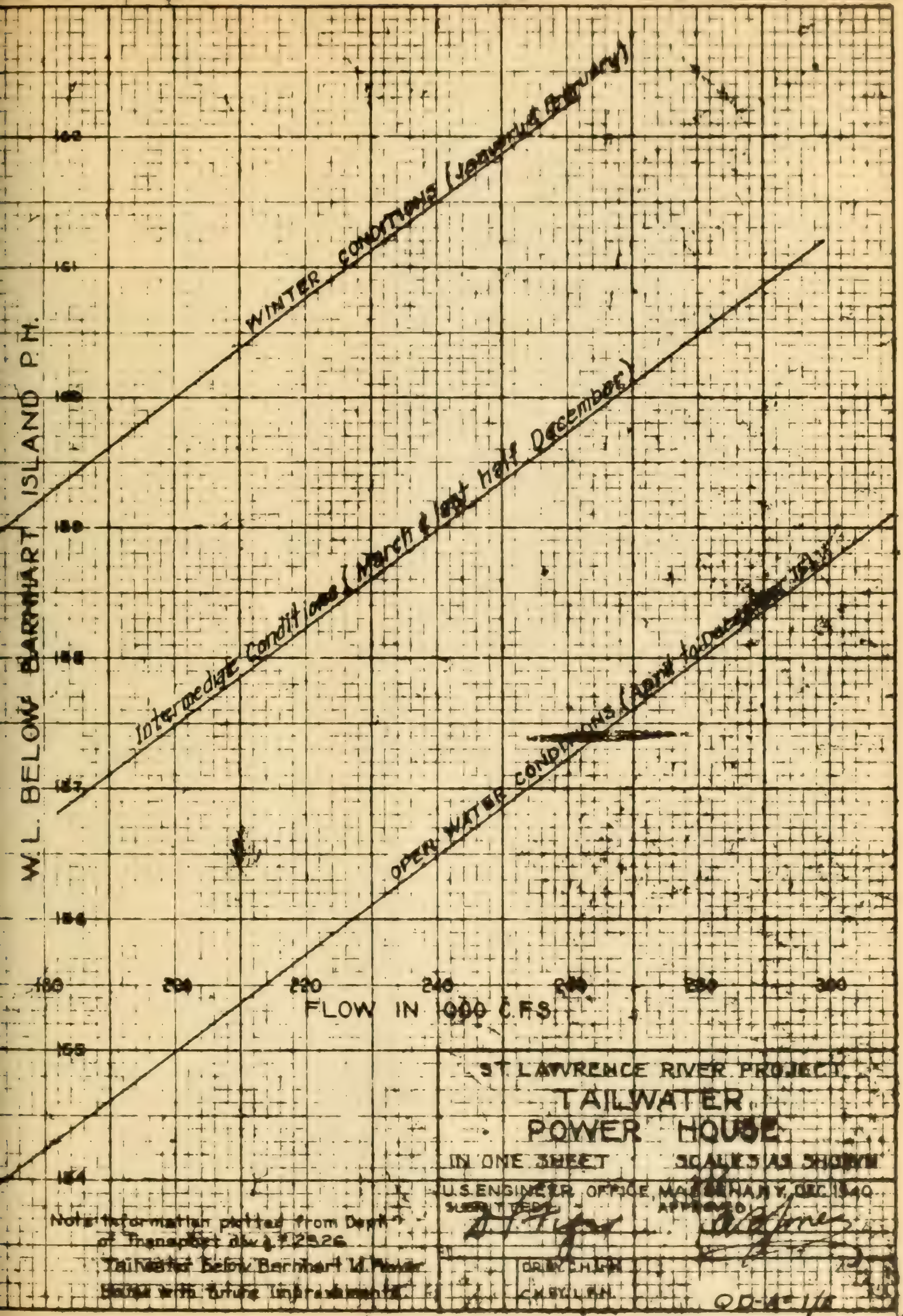

DISTANCE IN 1000 FEET
5
10
15
20
25
30
35
40
45
50
55
60
65
70
80
140
145
150
155
160
165
170
175
180
185
190
195
200
205
210
215
220
225
230
235
240
245
ROCKAWAY PT
IROQUOIS
HEAD OF OGDEN ISLAND
WADDINGTON
MORRISBURG
HEAD SHEEK ISLAND
AULTSVILLE
CAT ISLAND DAMSITE
FARRANS POINT
LONG SAULT DAM
BARNHART ISLAND
TAIL BAY BARNHART ISLAND RH
COTTON MILL—CORNWALL
Maximum late level at Massena Pier · Oct 1862 · 210,000 c.f.s.
Present Bed
CHANNEL
Channel
ST
TEN
BACKWATER
Note
Water elevations … obtained from … dated Nov 1940
Profile of channel … from topographic map of St. Lawrence Waterway, … dated … 1940
IN ONE SHEET
U.S. ENGINEER OFFICE … N.Y. DISTRICT
DATE

PLATE-XI-D

AR DEPARTMENT CORPS OF ENGINEERS, U.S. ARMY

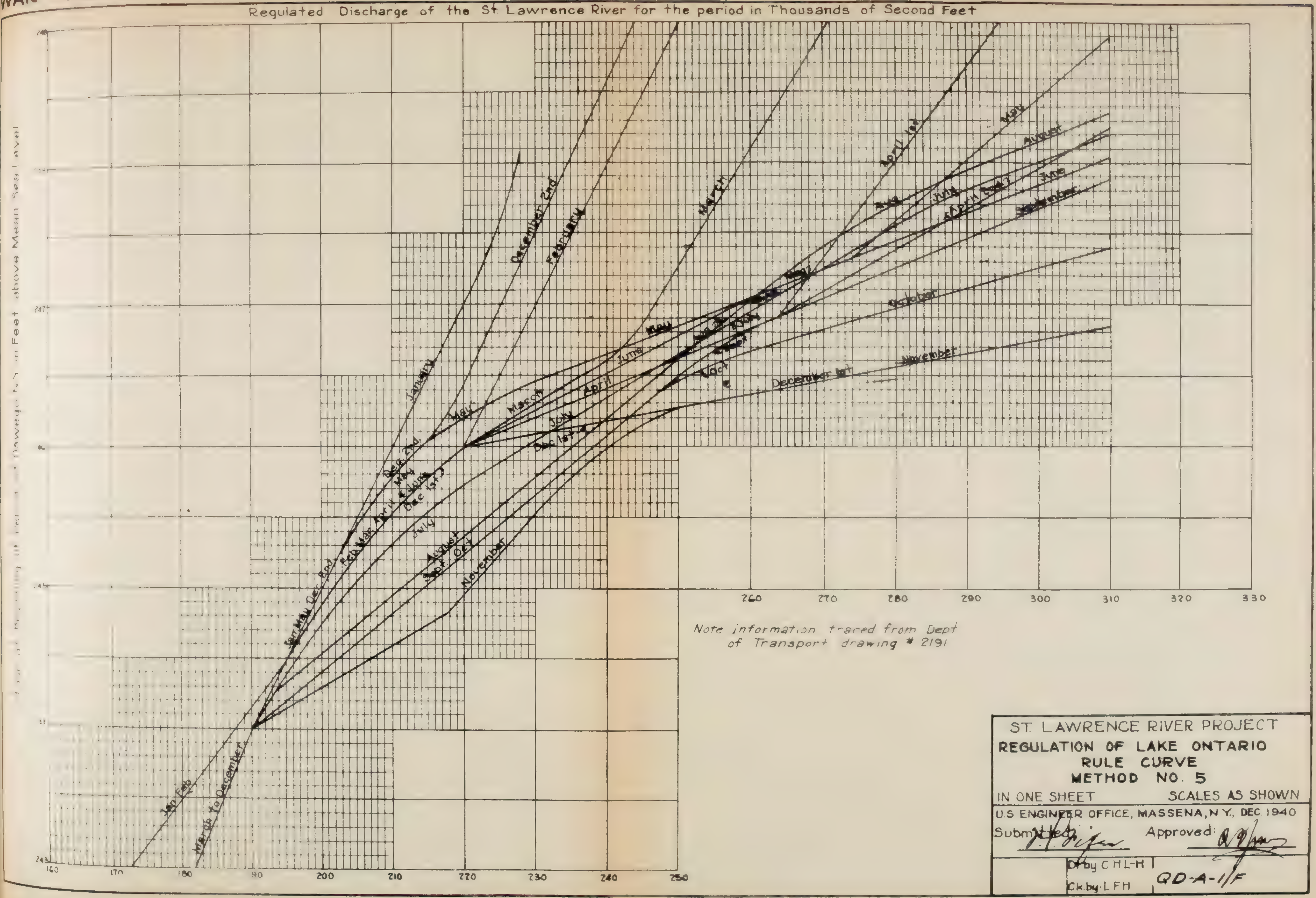


Note: Information plotted from Dept. of Transport dwg. #2526 Tailwater below Barnhart Id. Power House with future improvements.

ST. LAWRENCE RIVER PROJECT
TAILWATER
POWER HOUSE
IN ONE SHEET SCALES AS SHOWN
U.S. ENGINEER OFFICE, MASSENA, N.Y., DEC. 1940
SUBMITTED: D. T. Piper
APPROVED:
DRN. BY C.H.G.H.
CK. BY L.A.N.
QD-4-1/6

-PLATE XI-E

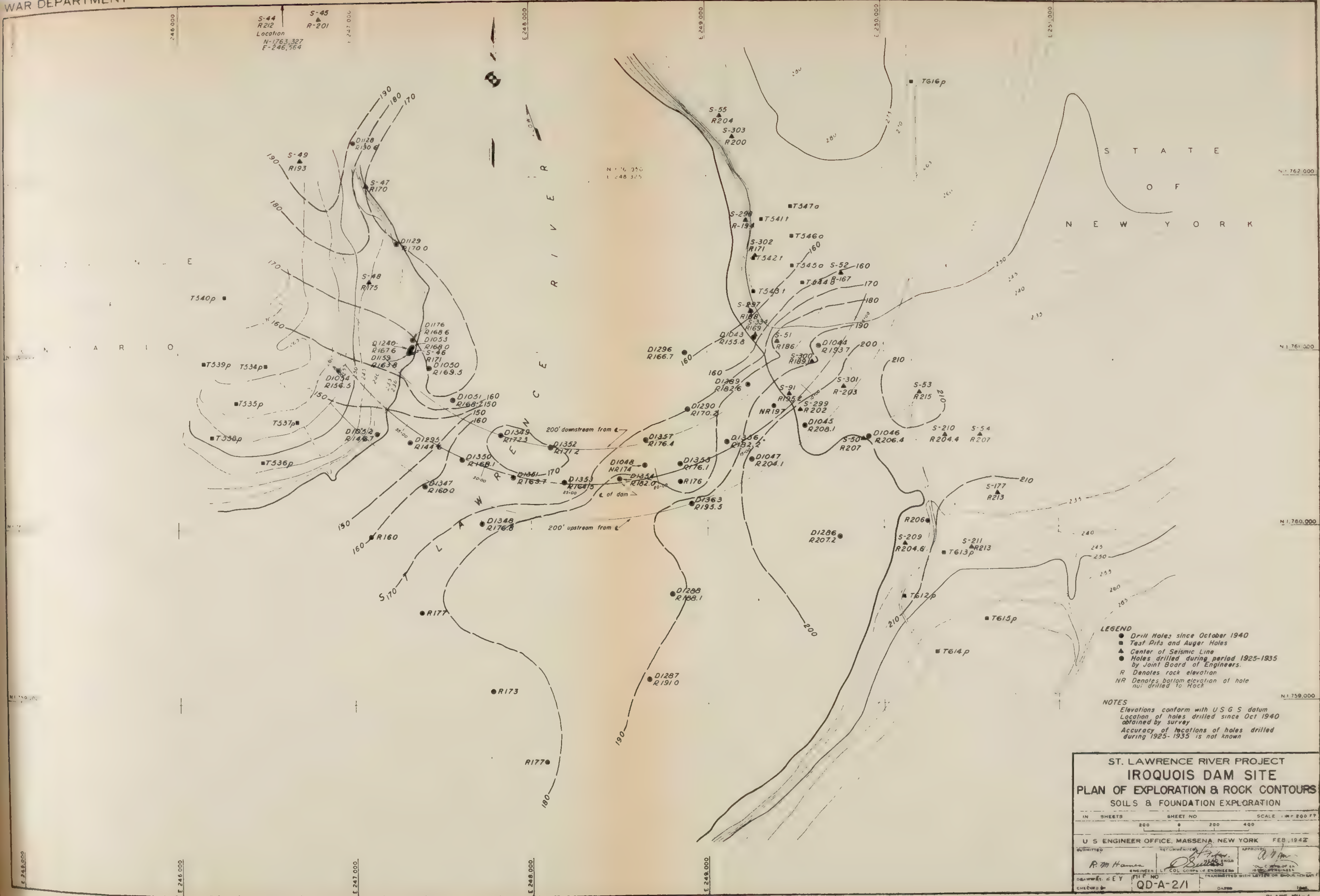
**WAR DEPARTMENT** **CORPS OF ENGINEERS, U.S. ARMY**



Note information traced from Dept of Transport drawing # 2191

ST. LAWRENCE RIVER PROJECT
REGULATION OF LAKE ONTARIO
RULE CURVE
METHOD NO. 5
IN ONE SHEET SCALES AS SHOWN
U.S ENGINEER OFFICE, MASSENA, N.Y., DEC. 1940
Submitted: Approved:
Dr. by C H L-H
Ck. by L F H
QD-A-1/F

- PLATE XI-F



LEGEND
- ● Drill Holes since October 1940
- ■ Test Pits and Auger Holes
- ▲ Center of Seismic Line
- ● Holes drilled during period 1925-1935 by Joint Board of Engineers.
- R Denotes rock elevation
- NR Denotes bottom elevation of hole not drilled to Rock

NOTES

Elevations conform with U S G S datum

Location of holes drilled since Oct 1940 obtained by survey

Accuracy of locations of holes drilled during 1925-1935 is not known

ST. LAWRENCE RIVER PROJECT

# IROQUOIS DAM SITE

## PLAN OF EXPLORATION & ROCK CONTOURS

SOILS & FOUNDATION EXPLORATION

IN SHEETS SHEET NO SCALE 1 IN = 200 FT

200 0 200 400

U S ENGINEER OFFICE, MASSENA, NEW YORK FEB, 1942

SUBMITTED ENGINEER

RECOMMENDED HEAD ENGR LT COL CORPS OF ENGINEERS

APPROVED

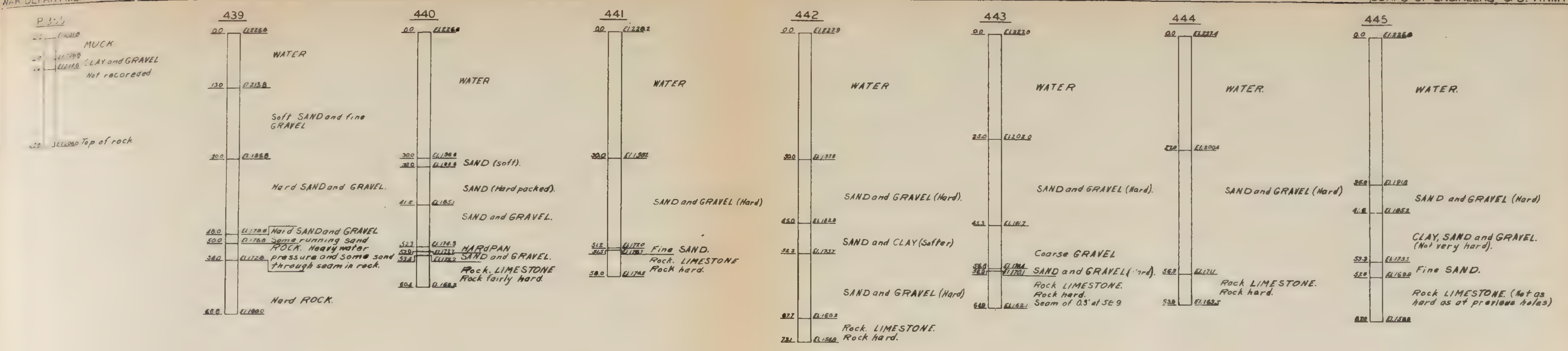
DRAWN BY

CHECKED BY

FILE NO QD-A-2/1

TRANSMITTED WITH LETTER OR SHOW SCHEDULE

DATED



Notes:
These holes were drilled during the period 1925 1935 by the Joint Board of Engineers.
Elevations are based on Mean Sea Level
Analyses of overburden are based on wash boring
Analyses of rock are based on cores obtained from drilling.

ST. LAWRENCE RIVER PROJECT

IROQUOIS DAM SITE

RECORD OF FOUNDATION EXPLORATION

DRILLING DURING 1925-1935

IN SHEETS | SHEET NO | SCALE 1"=10' VERTICAL

10 0 10 20

U S ENGINEER OFFICE, MASSENA, NEW YORK | FEBRUARY, 1942

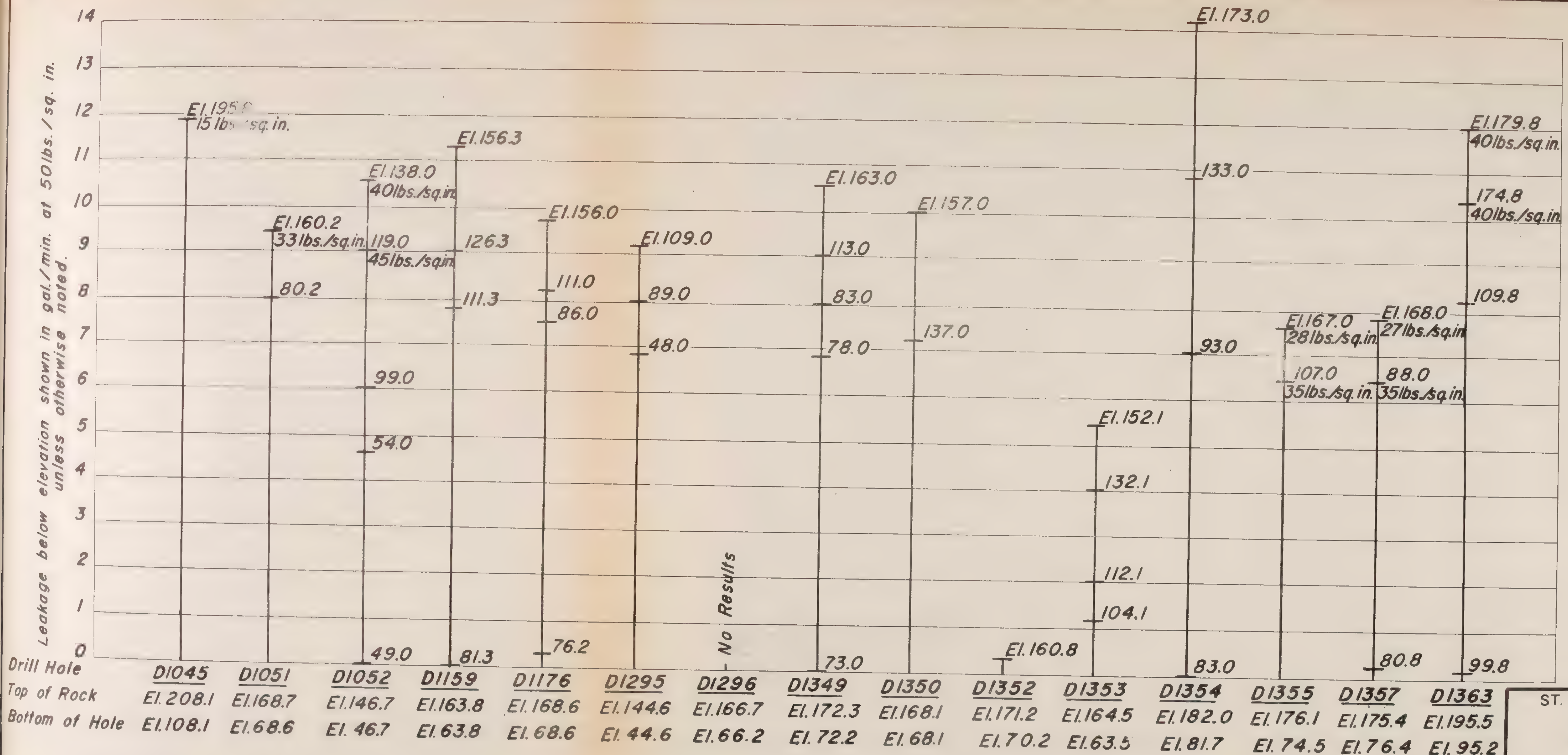
SUBMITTED | RECOMMENDED | APPROVED
ENGINEER | LT COL CORPS OF ENGINEERS | COL CORPS OF ENGINEERS DISTRICT ENGINEER

DRAWN BY F R S
CHECKED BY
FILE NO QD-A-2/2
TRANSMITTED WITH LETTER OR ENDORSEMENT
DATED ____________ 1941

PLATE XII - 2

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



ST. LAWRENCE RIVER PROJECT
IROQUOIS DAM SITE
RESULTS OF PRESSURE
TESTS IN ROCK

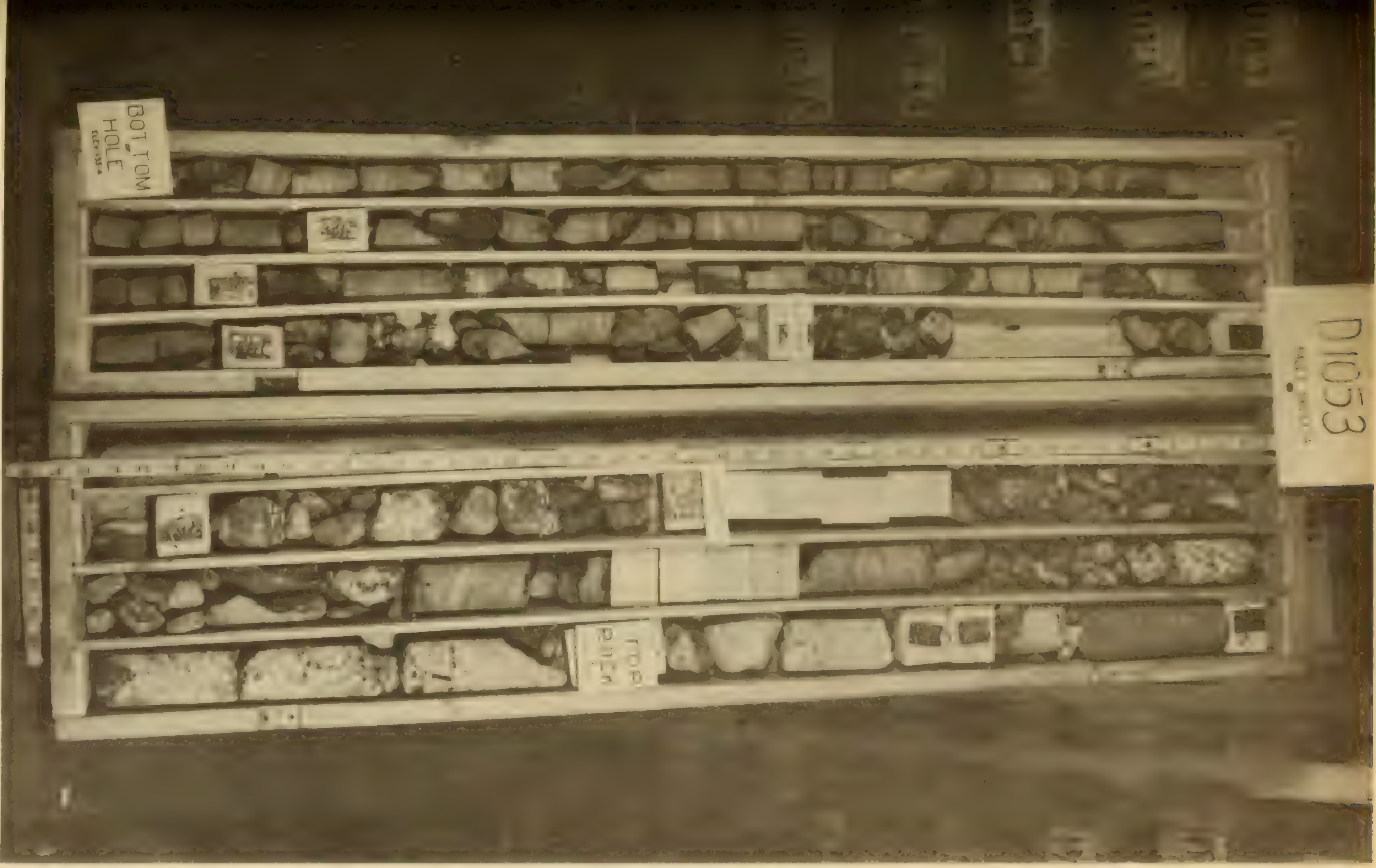
U.S. ENGR. OFFICE, MASSENA, N.Y. FEB., 1942

SUBMITTED:
R. M. Haines
ENGINEER

RECOMMENDED:
HEAD ENGR.
LT. COL.
CORPS OF ENGRS.

APPROVED:
COL.
CORPS OF ENGRS.
DISTRICT ENGR.

FILE NO. QD-A-2/3
PLATE XIII-1



U. S. Engineer Office
St. Lawrence River District
Massena, N. Y.

Fault Breccia in Drill Hole D-1053

November 8, 1941
File No. D-35

Plate XIII-2

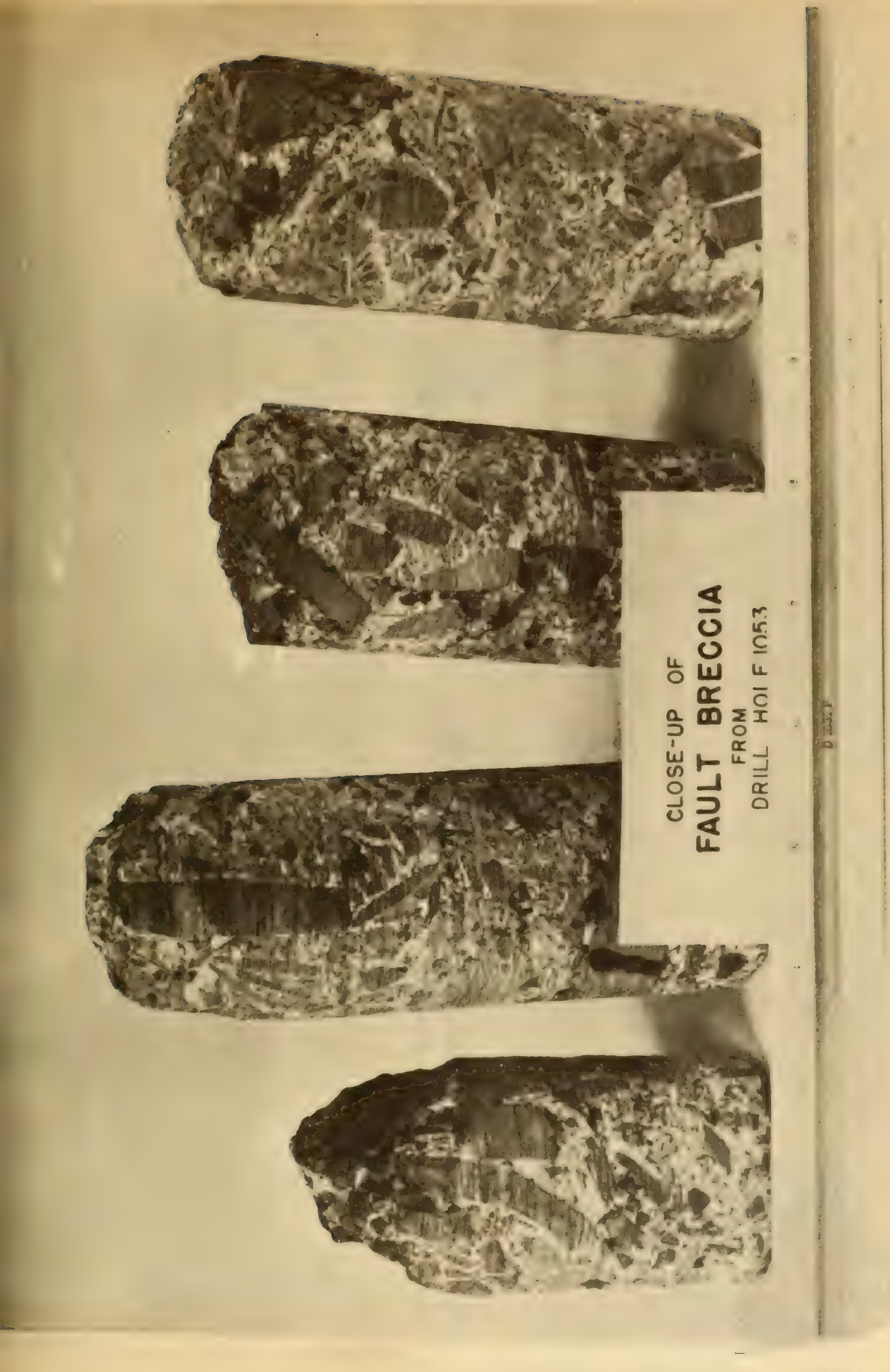
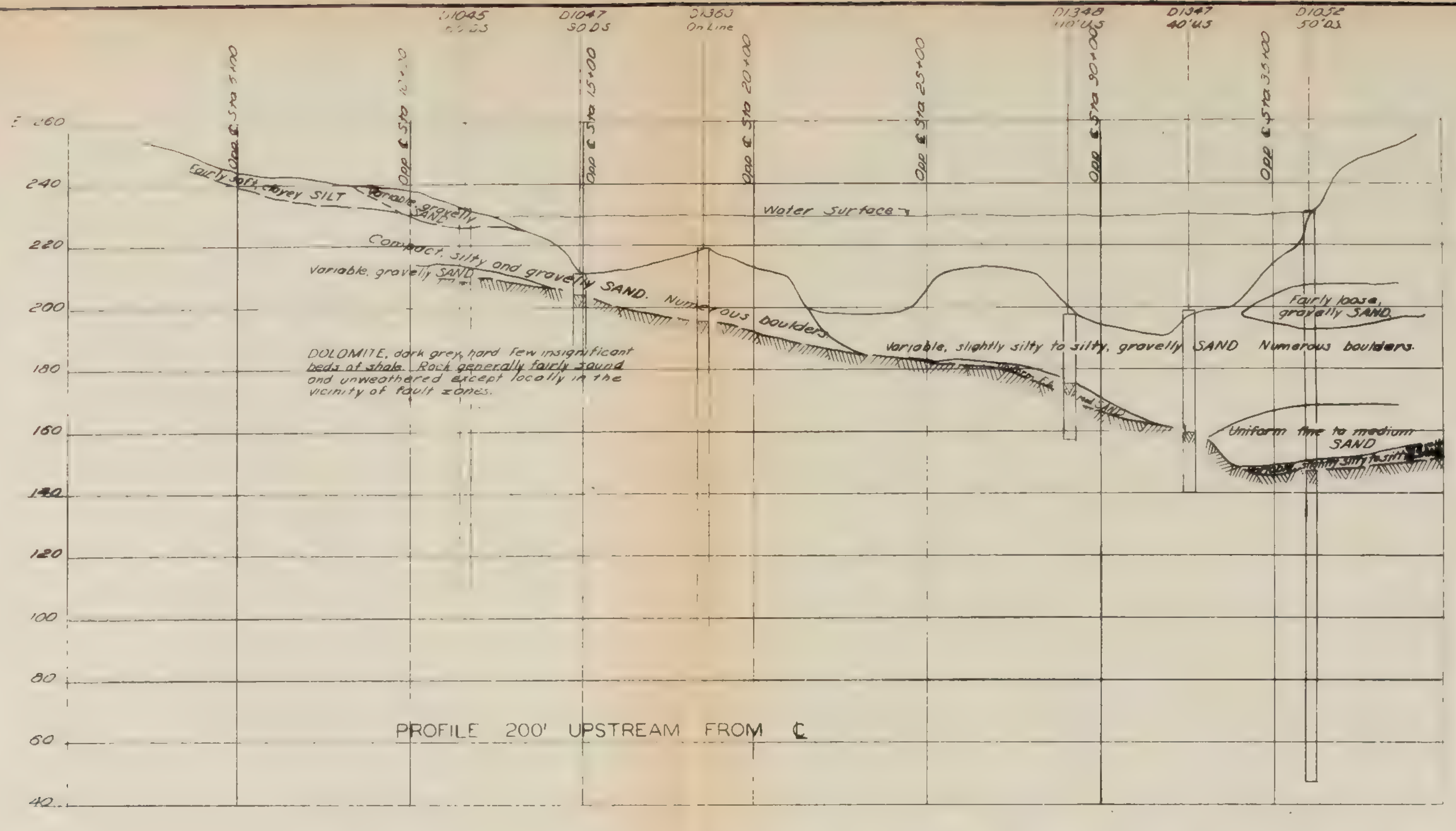
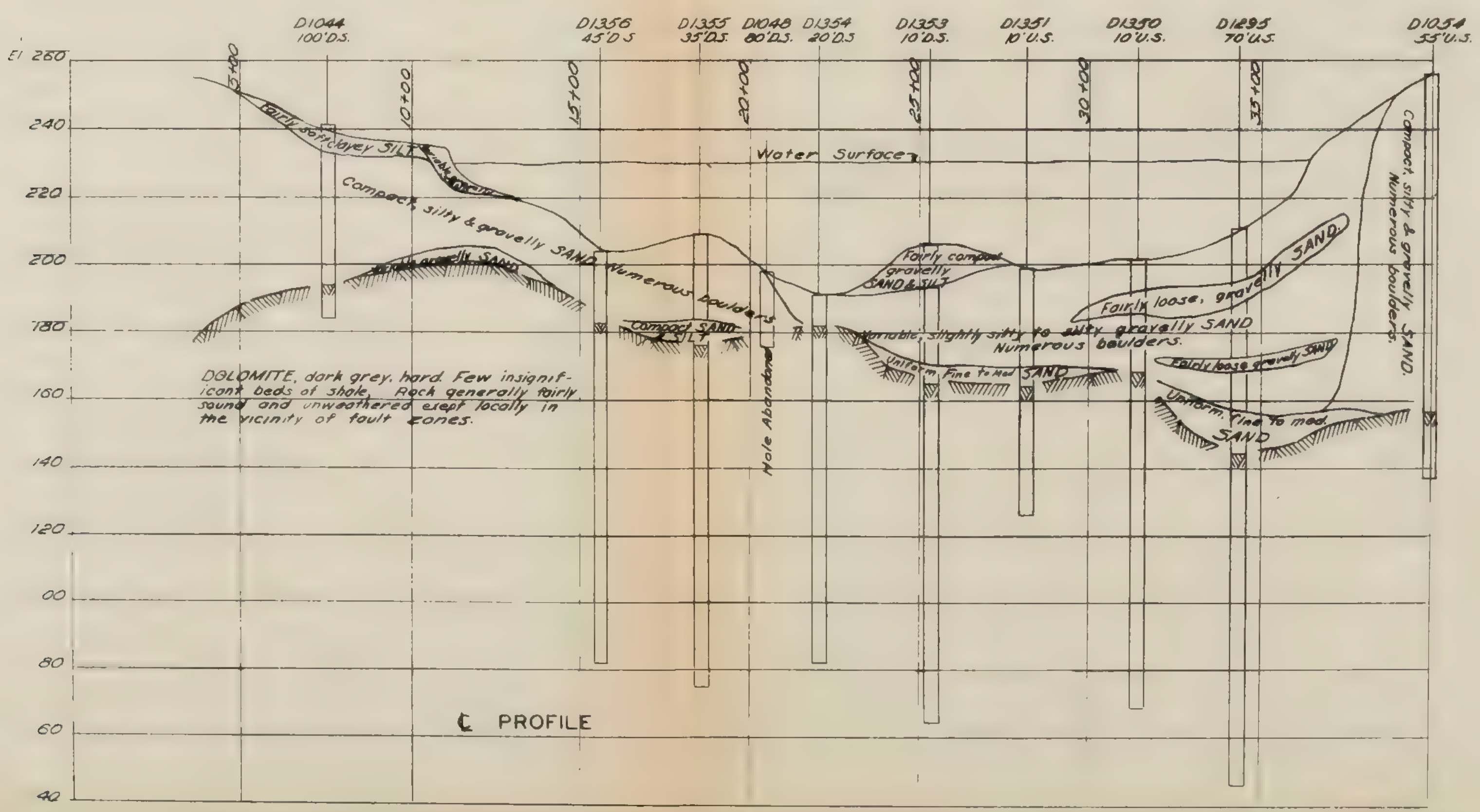


Plate XIII - 3


D1045
D.S
D1047
50'D.S
D1363
On Line
D1348
U.S
D1347
40'U.S
D1052
50'D.S
Opp ℄ Sta 5+00
Opp ℄ Sta 10+00
Opp ℄ Sta 15+00
Opp ℄ Sta 20+00
Opp ℄ Sta 25+00
Opp ℄ Sta 30+00
Opp ℄ Sta 35+00
El 260
240
220
200
180
160
140
120
100
80
60
40
Fairly soft, clayey SILT
Variable gravelly SAND
Compact, silty and gravelly SAND. Numerous boulders
Variable, gravelly SAND
Water Surface
Variable, slightly silty to silty, gravelly SAND Numerous boulders.
Fairly loose, gravelly SAND
Uniform fine to medium SAND
DOLOMITE, dark grey, hard Few insignificant beds of shale. Rock generally fairly sound and unweathered except locally in the vicinity of fault zones.

PROFILE 200' UPSTREAM FROM ℄


D1044
100'D.S.
D1356
45'D.S
D1355
35'D.S.
D1048
80'D.S.
D1354
20'D.S
D1353
10'D.S.
D1351
10'U.S.
D1350
10'U.S.
D1295
70'U.S.
D1054
55'U.S.
5+00
10+00
15+00
20+00
25+00
30+00
35+00
El 260
240
220
200
180
160
140
120
100
80
60
40
Fairly soft clayey SILT
Compact, silty & gravelly SAND Numerous boulders
gravelly SAND
Water Surface
Compact SAND & SILT
Hole Abandoned
Fairly compact gravelly SAND & SILT
Variable, slightly silty to silty gravelly SAND Numerous boulders.
Uniform Fine to Med SAND
Fairly loose, gravelly SAND
Fairly loose gravelly SAND
Uniform, Fine to med. SAND
Compact, silty & gravelly SAND. Numerous boulders.
DOLOMITE, dark grey, hard. Few insignificant beds of shale, Rock generally fairly sound and unweathered exept locally in the vicinity of fault zones.

℄ PROFILE

ST. LAWRENCE RIVER PROJECT
**IROQUOIS DAM SITE**
**GEOLOGICAL PROFILES NO. I**
SOILS & FOUNDATION EXPLORATION

IN 2 SHEETS SHEET NO I SCALE HORZ 1" = 200' VERT 1" = 20'

200 0 200 400

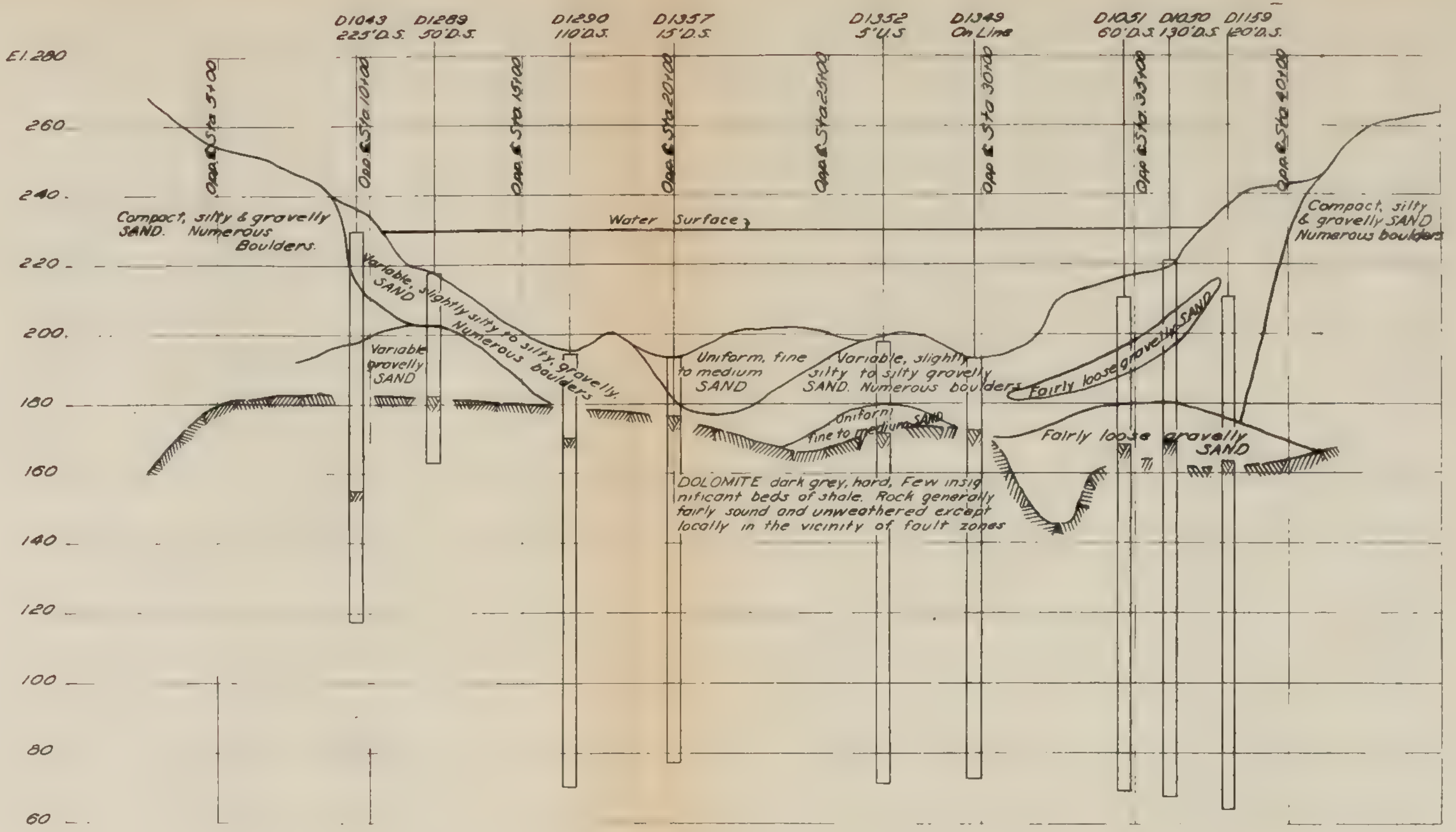
U S ENGINEER OFFICE MASSENA NEW YORK FEBRUARY, 1942

| SUBMITTED: | RECOMMENDED: | APPROVED: |
|---|---|---|
| R M Hanna<br>ENGINEER | HEAD ENGR<br>LT COL, CORPS OF ENGINEERS | COL, CORPS OF ENGINEERS<br>DISTRICT ENGINEER |

| DRAWN BY: | FILE NO | TRANSMITTED WITH LETTER OR ENDORSEMENT |
|---|---|---|
| CHECKED BY: | QD-A-2/4 | DATED __________ 194 |

WAR DEPARTMENT

CORPS OF ENGINEERS U.S. ARMY



D1043 225'D.S.
D1289 50'D.S.
D1290 110'D.S.
D1357 15'D.S.
D1352 5'U.S
D1349 On Line
D1051 60'D.S.
D1050 130'D.S.
D1159 120'D.S.
El. 280
260
240
220
200
180
160
140
120
100
80
60
Opp. ℄ Sta 5+00
Opp. ℄ Sta 10+00
Opp. ℄ Sta 15+00
Opp. ℄ Sta 20+00
Opp. ℄ Sta 25+00
Opp. ℄ Sta 30+00
Opp. ℄ Sta 35+00
Opp. ℄ Sta 40+00
Compact, silty & gravelly SAND. Numerous Boulders.
Water Surface
Variable, SAND
slightly silty to silty, gravelly. Numerous boulders
Variable gravelly SAND
Uniform, fine to medium SAND
Variable, slightly silty to silty gravelly SAND. Numerous boulders
Uniform fine to medium SAND
Fairly loose gravelly SAND
Fairly loose gravelly SAND
Compact, silty & gravelly SAND Numerous boulders
DOLOMITE dark grey, hard, Few insignificant beds of shale. Rock generally fairly sound and unweathered except locally in the vicinity of fault zones

PROFILE 200' DOWNSTREAM FROM ℄

ST. LAWRENCE RIVER PROJECT
**IROQUOIS DAM SITE**
**GEOLOGICAL PROFILES NO. 2**
SOILS & FOUNDATION EXPLORATION

IN 2 SHEETS SHEET NO. 2 SCALE VER 1" = 20' HOR 1" = 200'

200 0 200 400

U. S. ENGINEER OFFICE, MASSENA, NEW YORK FEBRUARY, 1942

SUBMITTED: ENGINEER

RECOMMENDED: HEAD ENGR. LT.-COL., CORPS OF ENGINEERS

APPROVED: COL., CORPS OF ENGINEERS DISTRICT ENGINEER

DRAWN BY: J.E.Y.
CHECKED BY: E.O.D.

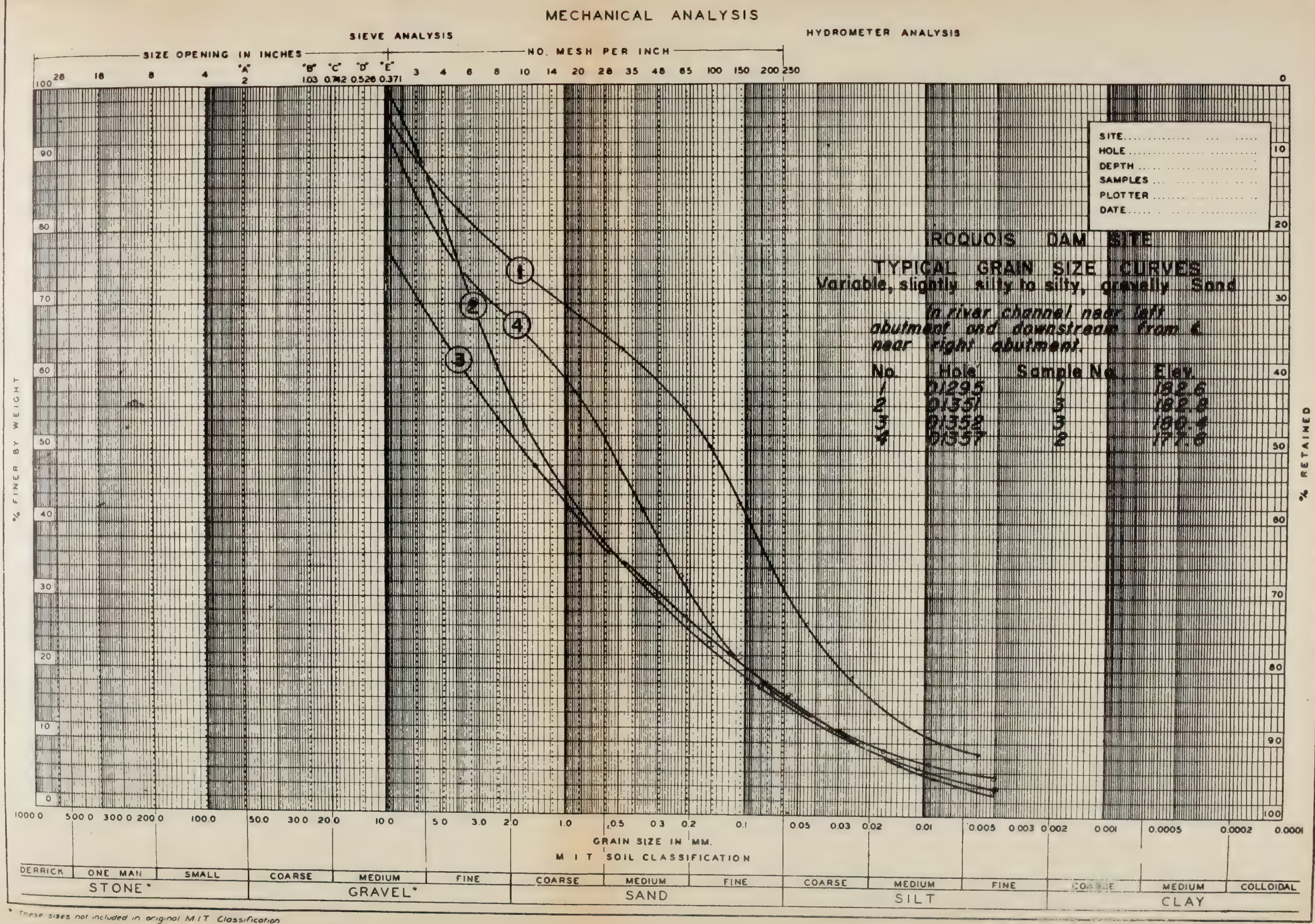
FILE NO. QD-A-2/5

TRANSMITTED WITH LETTER OR ENDORSEMENT
DATED ______ 194

PLATE XIII-5

WAR DEPARTMENT

CORPS OF ENGINEERS



## IROQUOIS DAM SITE

## TYPICAL GRAIN SIZE CURVES

Variable, slightly silty to silty, gravelly Sand

*In river channel near left abutment and downstream from ℄ near right abutment.*

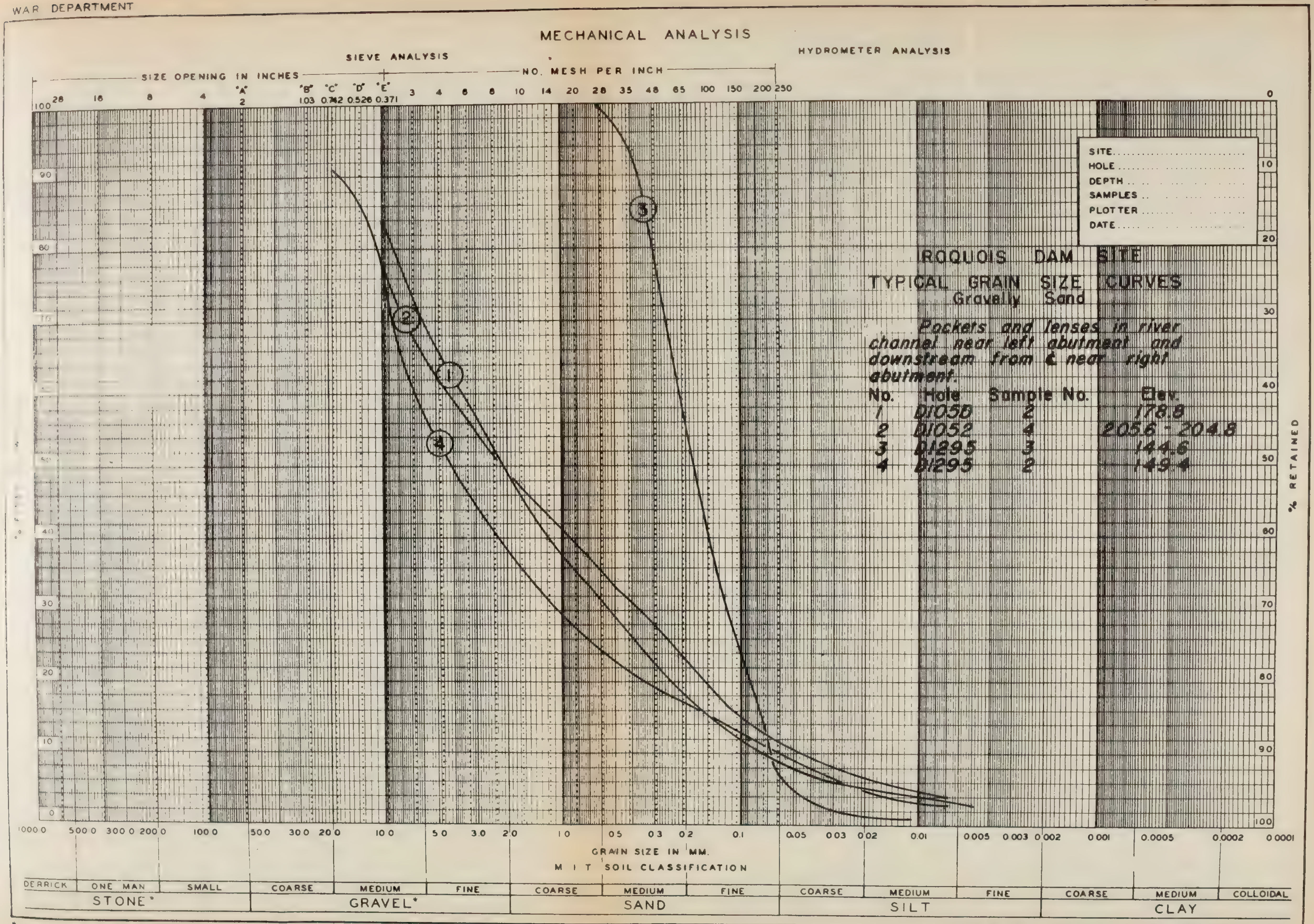
| No. | Hole | Sample No. | Elev. |
|---|---|---|---|
| 1 | 01295 | 1 | 182.6 |
| 2 | 01351 | 3 | 182.8 |
| 3 | 01352 | 3 | 180.4 |
| 4 | 01357 | 2 | 177.6 |

* These sizes not included in original M.I.T. Classification

SL - 5.00

WAR DEPARTMENT

CORPS OF ENGINEERS



IROQUOIS DAM SITE

TYPICAL GRAIN SIZE CURVES

Gravelly Sand

*Pockets and lenses in river channel near left abutment and downstream from ℄ near right abutment.*

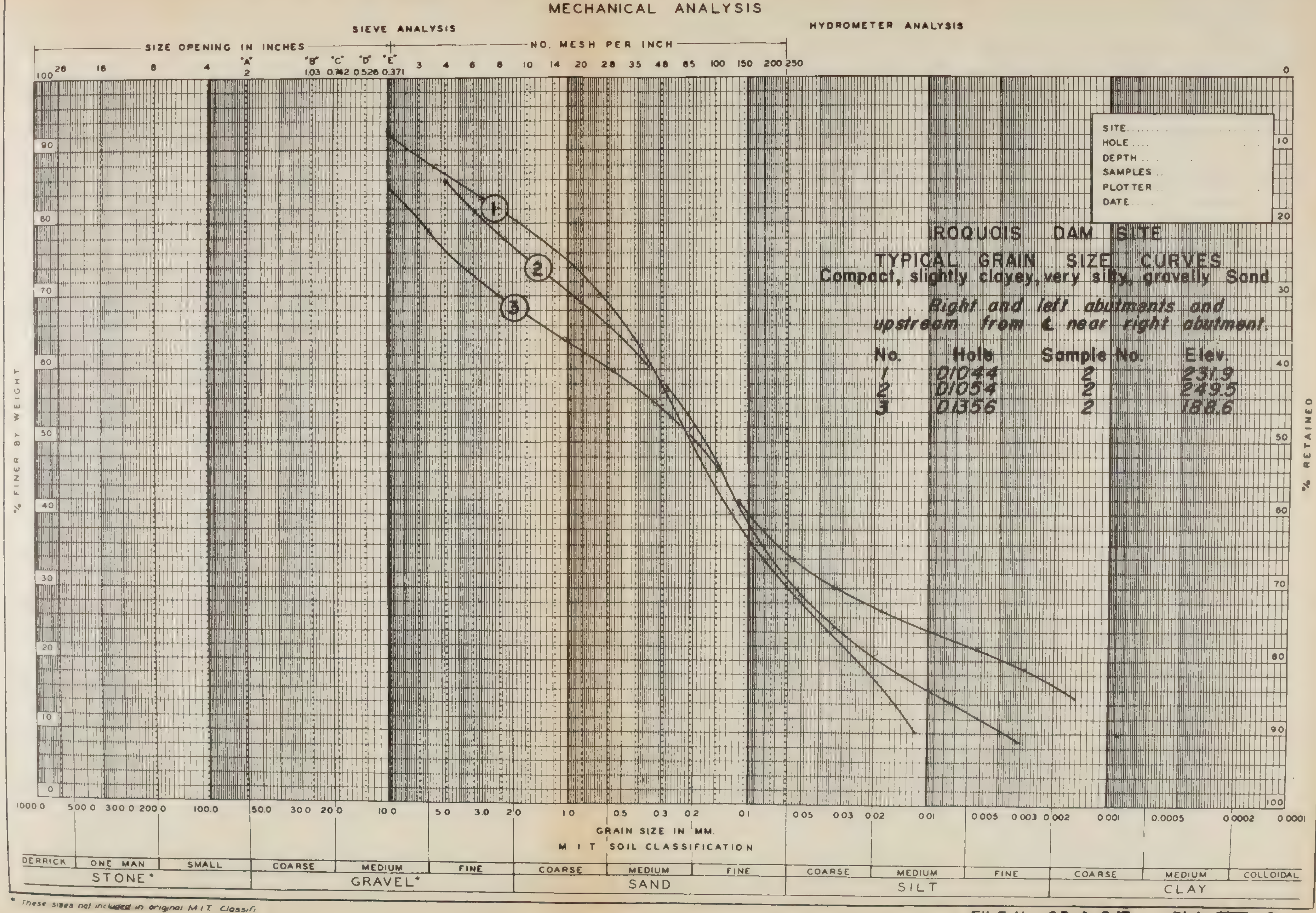
| No. | Hole | Sample No. | Elev. |
|---|---|---|---|
| 1 | D1050 | 2 | 178.8 |
| 2 | D1052 | 4 | 205.6 - 204.8 |
| 3 | D1295 | 3 | 144.6 |
| 4 | D1295 | 2 | 149.4 |

* These sizes not included in original M.I.T. Classification

WAR DEPARTMENT

CORPS OF ENGINEERS

# MECHANICAL ANALYSIS



## IROQUOIS DAM SITE

## TYPICAL GRAIN SIZE CURVES

**Compact, slightly clayey, very silty, gravelly Sand**

*Right and left abutments and upstream from ℄ near right abutment.*

| No. | Hole | Sample No. | Elev. |
|---|---|---|---|
| 1 | D1044 | 2 | 231.9 |
| 2 | D1054 | 2 | 249.5 |
| 3 | D1356 | 2 | 188.6 |

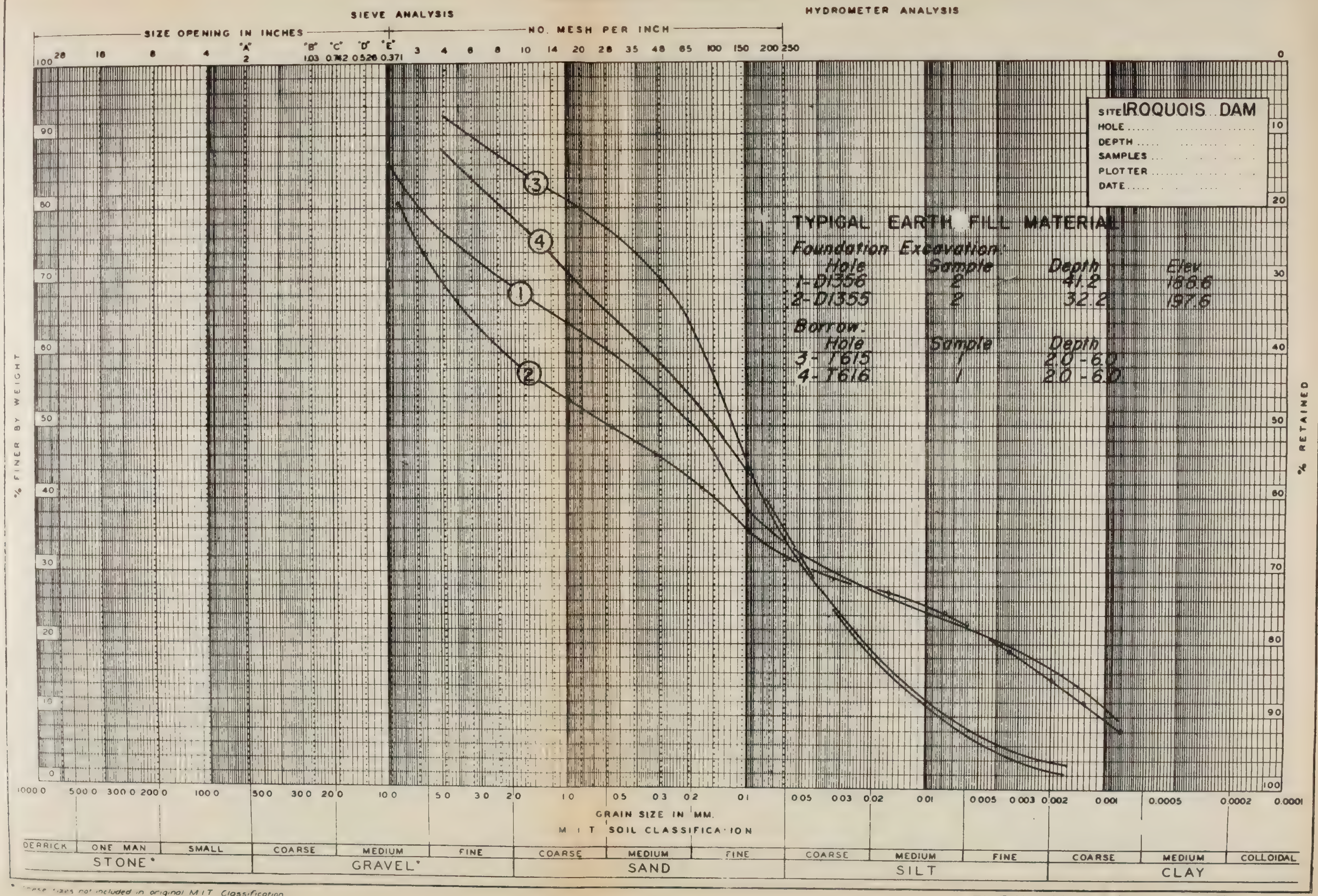
* These sizes not included in original M.I.T. Classifi

FILE No. QD-A-2/8 Plate XIII - 8

WAR DEPARTMENT

CORPS OF ENGINEERS

# MECHANICAL ANALYSIS



SITE IROQUOIS DAM
HOLE ......
DEPTH ......
SAMPLES ......
PLOTTER ......
DATE ......

## TYPICAL EARTH FILL MATERIAL

*Foundation Excavation:*

| Hole | Sample | Depth | Elev |
|---|---|---|---|
| 1-D1356 | 2 | 41.2 | 188.6 |
| 2-D1355 | 2 | 32.2 | 197.6 |

*Borrow:*

| Hole | Sample | Depth |
|---|---|---|
| 3-T615 | 1 | 2.0-6.0 |
| 4-T616 | 1 | 2.0-6.0 |

* These sizes not included in original M.I.T. Classification

FILE No.-QD-A-2/9 Plate XIII-9

SL-5.00

# PART TWO

# POINT ROCKWAY CANAL
# WEST OF STATION 159 + 50

## ANALYSIS OF DESIGN

# CONTENTS

Par. Page

## SECTION I - Introduction

1-01 General 1-1
1-02 Authorization 1-1
1-03 Description of Project 1-1

## SECTION II - Canal Alignment

2-01 Alternate Proposal 2-1
2-02 Selected Alignment 2-1

## SECTION III - Investigation of Overburden and Bedrock

3-01 Field Exploration of Overburden and Bedrock Conditions 3-1
3-02 Method and Extent of Laboratory Tests and Investigations 3-2

## SECTION IV - Design of Canal Excavation Slopes and Characteristics of Materials to be Excavated

4-01 Characteristics of Overburden 4-1
4-02 Characteristics of Bedrock 4-2
4-03 Analysis of Canal Slopes 4-2
4-04 Spoil Areas 4-2

Analysis of Design for Point Rockway Canal West of Sta. 159 +50

## SECTION I

## INTRODUCTION

1-01. GENERAL. - This design analysis presents the general basis of design based on information and data available at this date for the Point Rockway Canal between 32 + 00 and 159 + 50, a part of the development of the International Rapids Section of the St. Lawrence River.

1-02. AUTHORIZATION. - The proposed project is outlined in the Annex to the Message from the President of the United States dated March 21, 1941 H. D. No. 153, 77th Congress, First Session, as follows, in part:

> Agreement between the United States and Canada
>
> ANNEX
>
> Controlled Single Stage Project (238-242) for works on the International Rapids Section (St.Lawrence River). - The main features of the Controlled Single Stage Project (238-242)----- are as follows:
>
> (1) A control dam in the vicinity of Iroquois Point
>
> (2) - - - - - - - -
>
> (3) A side canal with one lock on the United States mainland to carry navigation around the control dam - -. All navigation channels to be excavated to 27 ft. depth.
>
> All works in the pool below the control dam shall be designed to provide for full Lake Ontario level but initially the pool shall be operated at maximum elevation 238.0.

1-03. DESCRIPTION OF PROJECT.

(a) Location. - The Point Rockway Canal is the side canal authorized in Item (3) of the foregoing authorization. The location on the American side of the proposed Iroquois Point Dam across the St. Lawrence River is preferable to one on the Canadian side for the reason, that any location on that side will involve more excavation in ledge rock than the selected location on the American side. This selected location provides fair entrances for large steamers entering and leaving the ship canal at either end. The basic considerations in the location of this ship canal have been taken as the following:

(1) The necessity for good visibility and resonably safe navigation throughout this canal.

(2) The necessity of easy entrance and exit for large and small vessels making the voyage up or down the St. Lawrence River.

(3) The relative safety and ease by which vessels may enter and leave the lock necessary to pass navigation around the Point Iroquois Dam.

(4) The comparative economy in the construction and maintenance of alternate locations.

(5) The comparative economy in the construction and operation of locks at alternate locations.

(b) General Description of Point Rockway Canal.

(1) In general the location follows the low ground to the south of the low knob known as Point Rockway, which is directly opposite the Town of Iroquois on the Canadian side, and shown on the contract plans. The

length of the ship canal proper is about 2½ miles. Channel improvement in the river at the upper entrance will entail the removal of shoals for about 1½ miles. At the lower entrance shoal dredging in the river will be necessary for about 1/2 mile.

(2) Throughout the canal proper the bottom width has been set at 442 feet in conformity with the findings of the Joint Board of Engineers in 1926. At both entrances to the canal the channel has been flared to meet the needs of vessels approaching or leaving the canal in the inevitable cross currents due to the flow of the river.

(3) From the upper entrance to the Point Rockway Lock the bottom grade in earth excavation has been set at Elev. + 213 MSL in conformity with the requirement of 27 feet depth expressed in the authorization, (see par. 1-02, topic 3 et seq.). Where the channel encounters, ledge rock, the bottom grade has been lowered to Elev. +210 in agreement with the usual engineering practice throughout the Great Lakes and their connecting channels for the purpose of lessening damage to vessels by slabs of stone washed loose from the channel bottom.

(4) From the Point Rockway Lock to the river below the Iroquois Point Dam the bottom of the channel has been set at Elev. +206 MSL in accordance with the requirements expressed in the foregoing. After thorough consideration of the characteristics of the earth and ledge rock encountered along the route of the canal, all side slopes in earth have been set at one vertical to two and one half horizontal while all side slopes in ledge rock have been set at four vertical to one horizontal.

(5) Practically all the Point Rockway Canal will be through pool areas with open water on both side of the canal. Therefore this channel has been designed for a bed width of 450 feet for 25 feet depth, modified to 442 feet for 27 feet depth. These widths and depths originate in the Report of the Joint Board of Engineers, dated November 16, 1926. On account of the canal being routed through some areas of soft clay formations, the spoil banks have been placed at what is considered a minimum safe distance from the edge of the canal to eliminated the danger of slides, which would probably cause high maintenance charges. The full bed width of 442 feet has been retained through the hard materials, thus dispensing with short bottlenecks in the canal which otherwise would occur, if the channel were reduced in width at these points.

(c) Geology.

(1) The Point Rockway Canal as shown in Plate III-1 lies in a broad, shallow valley which cuts across the base of the Rockway Point peninsula and almost seperates Rockway Point from the New York mainland. During the high water conditions possibly caused by ice-damming of the main channel, it is believed that part of the river flowed at several times through this valley. Near the middle of the valley is a low, swampy divide from which the drainage flows sluggishly eastward and westward through low, marshy flats to the St. Lawrence River. The low hills which form the sides of this valley are composed almost entirely of glacial till. This material was scraped off the bottom of the advancing ice during the last glacial period and is a compact, heterogeneous mass of all sized material from clay to boulders. In a few areas loose, pervious material, mostly sand and gravel which was dropped from the retreating ice front, cover the compact till. In the valley bottom and extending in some localities up the sides of the till hills are deposits of loose marine silt and clay. This material was deposited in the salt waters of the Champlain Sea which flooded the region when the glacier withdrew. The loose, pervious sand and gravel dropped from the retreating ice on the surface of the till hills extends in a few places across the valley bottom beneath the marine silt and

clay. It is in these pervious deposits under the clay that artesian water was encountered in some drill holes. Some of the low parts of the valley floor have been filled with recent organic muck, and one small deposit of marl was found.

(2) The bedrock is composed of massive dolomite with a few insignificant beds of shale. The rock is hard, generally sound and unweathered. This rock is part of the Beekmantown formation which is lower Ordivician in age. A few outcrops have been found on the south side of the valley. The rock slopes generally from south to north except west of and at the low divide where small bedrock knolls rise almost to the ground surface. Rock is fairly deeply buried under the entire eastern side of the present valley.

(d) Recommended Contract Arrangements. - Since the Point Rockway Canal as located will pass through two separated bodies of ledge rock considerable interest has been taken in the economical disposition of the stone to be excavated from the canal prism. After painstaking investigation of the character and amount of stone to be removed from each body of ledge rock it has been concluded that sufficient coarse aggregate (see par. 3-02 (b)) and rock fill may be obtained from the rock body west of Sta. 159 + 50 to fulfill all the needs of the proposed Iroquois Point Dam. In like manner sufficient coarse aggregates (see par. 3-02 (b)) and rockfill for the proposed Point Rockway Lock can be obtained from the rock body east of Sta. 159 + 50. It has therefore been considered advantageous to embody the canal excavation west of this point in the contract for the Iroquois Point Dam and the excavation east of this point in the contract for the Point Rockway Lock.

## SECTION II

## CANAL ALIGNMENT

2-01. ALTERNATE PROPOSAL. - Several alignments have been studied to give the best conditions for navigation and the present alignment was selected for the reason that it meets the requirements best and at lowest cost.

(a) Due to the presence of ledge rock at such a high elevation in the present location, the alignment was shifted both north and south in an attempt to lower the cost of construction. In moving the canal north it was found the rock quantities reduced but the common excavation quantities increased to such an amount that the cost of construction was greatly increased. At the same time the approach to the canal at the upper end was made more hazardous due to the close proximity of the Iroquois Dam. In moving the canal south it was found that the rock was at a higher elevation thereby greatly increasing the cost of construction.

2-02. SELECTED ALIGNMENT. - Having in mind the hazards to large steamers of the present and future while operating in narrow and constricted channels with uncertain cross currents combined with darkness, fog, snow and high winds, every effort has been made to select a location on which will minimize these hazards. Particular attention has been given to the flaring of the upper entrance to the canel which a pilot can find in a fog or snow storm, with no great change in course, thereby minimizing the hazard of the immediately adjacent Iroquois Dam. The flare at the lower entrance has been laid out with the purpose of allowing upbound and downbound vessels to meet without danger of collision due to the cross currents at this entrance.

# SECTION III

## INVESTIGATIONS OF OVERBURDEN AND BEDROCK

### 3-01. FIELD EXPLORATION OF OVERBURDEN AND BEDROCK CONDITIONS.

(a) General. - Exploration completed to date at the Point Rockway Canal site to determine the overburden and bedrock conditions included drilling in overburden and rock, excavation and sampling of auger holes, probing in soft overburden, the determination of bedrock elevations and study of general soil conditions by the seismic method, and extensive geological reconnaissance. The general conditions and surface topography of the bedrock were determined to locate the lock and alignment of the canal. The location of all drill holes and seismic lines completed to date are shown on Plate III-1 and one tabulated on Plate III-2 and III-3. The location and extent of exploration except seismic lines for final design between stations 32 + 00 and 159 + 50 are shown on sheets QD-1-190/2 to QD-1-190/4 of the contract drawings for the Iroquois Dam. The records of drilling and probing in the canal between stations 32 + 00 and 159 + 50 are shown on sheets QD-1-190/5 to QD-1-190/10 of the same contract drawings. Similar drawings will be prepared for other sections of the canal as the final design of the Point Rockway Lock progresses. Complete field logs of the drill holes and probings, and the results of the seismic investigations are on file in the St. Lawrence River District Office. All soil samples and rock cores are stored in the District Soils Laboratory.

(b) Drill Holes. - Holes of two sizes were drilled in the vicinity of the canal. Holes for the purpose of determining both overburden and bedrock conditions were drilled with diamond core drilling equipment using 3½ inch casing in the overburden and 2-1/6 inch bit to obtain rock cores. Soil samples were usually taken at 5 foot intervals or at changes in material with a dry sampling tube, 2 inches in diameter. One hole, D-1336 was drilled in the overburden in the vicinity of the lock using a 6 inch casing to obtain undisturbed samples of clay. A spoon specially constructed by Sprague & Henwood, Inc. was used. A spoon obtains samples 4-5/8 inches in diameter and has recessed flaps above the cutting shoe which are closed with a wire snare to retain the sample in the spoon. The spoon is also equipped with steel liners, 0.12 inches thick and 12 inches long. To date, 26 holes have been drilled using 3½ inch casing with a total footage of 626 feet in overburden and 520 feet in rock. One hole using 6 inch casing has been completed with a total footage of 32.3 feet in overburden. 15 undisturbed clay samples were obtained. Between stations 32 + 00 and 159 + 50, 14 holes have been drilled as shown on sheets QD-1-190/2 to QD-1-190/4 of the contract drawings using 3½ inch casing with a total footage of 281 feet in overburden and 292 feet in rock.

(c) Probings. - Holes were probed along the sides of the proposed canal and on the center line, in general spaced every 300 feet. The holes were probed with a Highmark Probing Machine using a 1-1/4 inch diameter probing pipe with a removable closed pointed end. Samples were taken with a sampler 3/8 inches in diameter after the closed pointed end was retracted without pulling the casing. The probing pipe was driven with a hammer weighting 164 pounds, dropping approximately 12 inches at an average rate of 50 blows per minute. To date, 203 holes have been probed with a total footage of 2,912. The location and records of the probings completed between station 32 + 00 and 159 + 00 are shown on sheets QD-1-190/2 to QD-1-190/4 of the contract drawings. Between stations 32 + 00 and 159 + 00, 105 probe holes have been completed with a total footage of 1,672.

(d) Auger Holes. - Holes 1½ and 5 inches in diameter were augered in valley and on the hills in the vicinity of the canal to determine the overburden conditions which govern the location of spoil areas. A sufficient number of auger holes were excavated to determine the approximate extent of the clay areas. No record was kept of the location of the holes or the soil conditions at each hole. The limits of the clay areas were sketched in the field on a topographical site may.

(e) Seismic Investigations. - Preliminary investigations for determining the location of bedrock and existing soil conditions in the vicinity of the canal were conducted using the seismic method. The method used was developed by E. R. Shepard, Senior Physicist, Office of the Chief of Engineers (for a brief description, see article "The Seismic Method of Exploration Applied to Construction Projects" by E. R. Shepard, The Military Engineer, September-October 1939). A total of 50 seismic lines were fired in the vicinity of the canal.

## 3-02. METHOD AND EXTENT OF LABORATORY TESTS AND INVESTIGATIONS.

(a) Soil Tests.

(1) Due to the type of overburden materials and the depth of excavation for the canal, an extensive program of soil testing was not made. To permit a design of the excavation slopes for the lock, a more extensive program of testing is in progress. Soil samples taken during drilling were classified using the M.I.T. scale of classification and recorded in a final report of each hole. The grain size distributions of a sufficient number of samples were determined by the usual sieve and hydrometer methods to serve as a guide in the classification of all samples. General geological descriptions of the overburden at each drill hole were prepared after studying the laboratory classifications and the field logs. The small soil samples obtained with the probing equipment were classified by a trained expert. Only a very general classification of each sample was recorded.

(2) No specific gravity, natural density determination or permeability tests were made on soil samples taken from the canal. Moisture contents of 89 samples from drill holes were determined. Testing is in progress on samples taken from D-11338 to determine the shear and consolidation characteristics, natural density, specific gravity, variation of water contents, and Atterburg limits of the clay at the lock site. The results of all testing which are completed to date are on file in the District Laboratory.

(b) Rock Tests. - The rock cores obtained by drilling were classified by an experienced geologist. The bedrock in the vicinity is dolomite of the Beekmantown formation and was apparently deposited at the same time as the bedrock in the vicinity of the quarry operated by the Northern Quarries, Inc., near Norwood, N. Y. Extensive tests are being conducted at the Central Concrete Laboratory to determine if the dolomite rock from the quarry of Northern Quarries, Inc. is satisfactory for concrete aggregate. Tests completed to date indicate that the rock will be satisfactory. To compare the bedrock which must be excavated in the canal with that from the quarry operated by Northern Quarries, Inc., cores obtained by drilling have been sent to the Central Concrete Laboratory for examination and test. Prior to letting the contract for excavation of the bedrock it is planned to make sufficient tests to definitely determine the suitability of the rock in the canal excavation for concrete aggregate.

## SECTION IV

## DESIGN OF CANAL EXCAVATION SLOPES AND CHARACTERISTICS OF MATERIALS TO BE EXCAVATED

### 4-01. CHARACTERISTICS OF OVERBURDEN.

(a) Distribution. - The overburden through which the canal will be excavated is variable and consists of marine clay, glacial till and water laid or partially water laid sands. The geological origin of the materials is described in paragraph 1-03 (c). The canal is bounded by hills composed of glacial till with the valleys between the hills being filled with clay. The canal site, in general is located in a clay valley. In some areas water laid or partially water laid sands have been deposited between the clay and the glacial till. As these conditions are very variable, a specific distribution of the various materials cannot be made with great accuracy with the information available. Using the data from the drilling and probings, the geological profiles between stations 32 + 00 to 159 + 50 as shown on plates IV-1 to IV-5 inclusive, have been prepared. Similar profiles will be prepared for the remainder of the canal as the design progresses. The basic data for the profiles are shown on sheets QD-1-190/5 to QD-1-190/10 inclusive, of the contract drawings. In preparing the profiles, it was assumed that the rate of probing in clay was less than 72 feet per hour, and therefore a probing rate greater indicated material other than clay.

(b) Characteristics of Clay. - The marine clay deposits consist of soft, grey, silty clay underlying at a depth from zero to approximately 10 feet, brown sandy clay. The brown, sandy clay is mainly deposited on the valley slopes and in the vicinity of the lock, Typical grain size curves of the grey silty clay are shown on Plate IV-6. The laboratory tests show that in general the grey clay consists of approximately 10 percent by weight collodial sizes. The water contents of grey clay varies between 40 and 70 percent but has an average of approximately 50 percent by weight. Based on this average water contents, the grey clay has an average void ration of 1:35, a unit dry weight of 72 pounds and unit saturated weight of 108 pounds. The shearing strength of the grey clay is believed to be about 600 pounds per sq. ft. based on testing experience of clays in the vicinity of the Long Sault Canal. The actual shearing strength of the clay at the lock site is being determined as stated in paragraph 3-02.

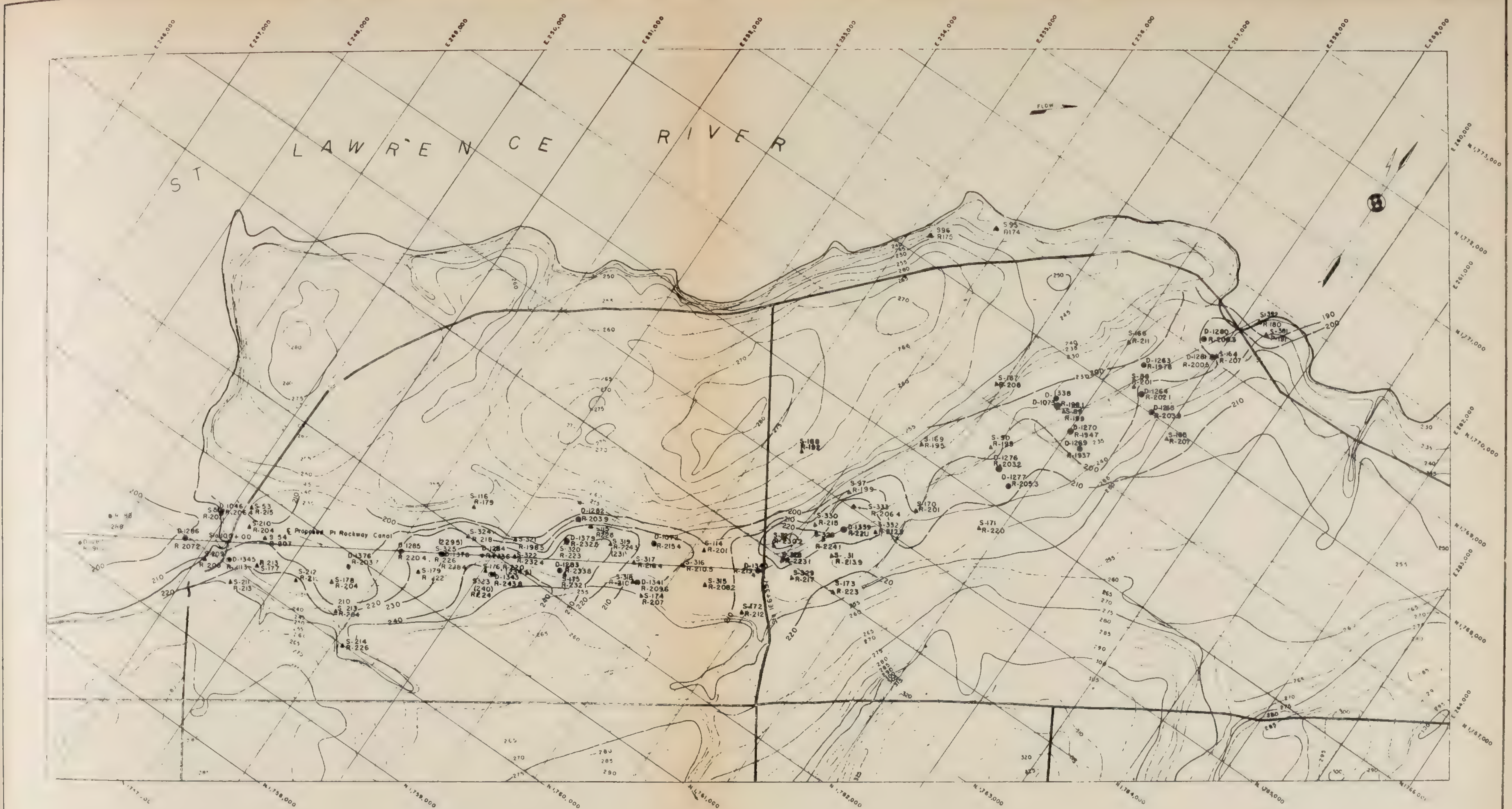
(c) Characteristics of Glacial Till. - The deposits of glacial till consists of fairly compact to compact clayey or silty gravelly sand, with scattered cobbles and boulders. In general the till near the exposed surface and contact surface with the clay contains less silt or clay than the underlying till. Within any deposit, there may be a great variation in the quantity of clay or silt which acts as a binder. The density and compactness depends upon the percentage of clay and silt particles but in general the till is very compact. Plate IV-6 shows grain size curves of various samples of till which are believed to be typical. No shear tests were performed on glacial till samples since experience with similar materials has shown that an angle of internal friction of 30 degrees and a cohesion of 0.10 tons per square foot may be used to obtain a conservative design. The glacial till is relatively impervious having a coefficient of permeability varying between 0.0001 and 0.000001 cm. per second.

(d) Characteristics of Overburden Other Than Clay and Glacial Till. - The overburden other than clay and glacial till consists of water laid or partially water laid sands and gravels, muck and marl. The characteristics of these materials are quite variable. No samples can be considered typical. For design purposes, it must be assumed that in locations where unusual conditions exist that stable side slopes will be formed during construction.

4-02. CHARACTERISTICS OF BEDROCK. - Description of the bedrock at the holes drilled between station 32 + 00 to 159 + 50 are shown on sheets QD-1-190/5 to QD-1-190/10 inclusive, of the contract drawings, and the bedrock contours are shown on Plate III-1. The bedrock is in general approximately horizontally bedded dolomite with a very few minor thin beds of shale and sandstone. The bedrock is quite sound and with a nominal grouting should provide a sound foundation for the proposed lock structure. The upper five to ten feet of the bedrock may be sufficiently jointed and weathered along the seams to make it unsuitable for concrete aggregate, although most of the rock is believed suitable. All bedrock is sufficiently sound for use as riprap and cofferdam construction.

4-03. ANALYSIS OF CANAL SLOPES. - No mathematical analyses have been made to determine the excavation slope in the canal required for safety against major slides. A study has been made of the depth of cut in clay and depth of clay. Based on this study and the results of analyses made for the excavation slopes for the Long Sault Canal, it is believed that a slope of 1 on 2½ will be amply safe against major slides. In some sections of the canal where unusual soil conditions exist, it may be necessary to excavate the slopes flatter than 1 on 2½. However, where these conditions exist, the slope that can be constructed is believed to be stable after construction. A slope of 1 on 2½ was selected for the design throughout the length of the canal since, based on experience, this slope will minimize maintenance.

4-04. SPOIL AREAS. - The rock excavated from the canal will be utilized in the construction of the Long Sault Dam and stock piled for future use as concrete aggregate, riprap, and rock fill for other structures. To prevent stockpiled rock from sinking into the overburden, the rock spoil area has been located on a deposit of firm overburden. The location of the spoil areas for material to be excavated between station 32 + 00 and 159 + 50 are shown on sheets QD-1-190/11 to QD-1-190/13 of the contract drawings. The location of the clay and firm material deposits along the canal as determined by the exploration described in paragraph 3-01 (d) are shown on Plate IV-3. Spoil areas for unclassified material have been located to insure the stability of the excavation slopes of the canal.



LEGEND

- ● DRILL HOLE
- ▲ CENTER OF SEISMIC LINE
- R DENOTES ROCK ELEVATION
- (240') PROBABLE FRACTURED ROCK

NOTES:

ELEVATIONS CONFORM WITH U S G S DATUM MSL 1912 adj

ST. LAWRENCE RIVER PROJECT

## POINT ROCKWAY CANAL

## SITE & ROCK CONTOUR MAP
## SOILS & FOUNDATIONS EXPLORATION

| IN SHEETS | SHEET NO | SCALE |
|---|---|---|
| | 1 | |

U S ENGINEER OFFICE, MASSENA, NEW YORK

| SUBMITTED | RECOMMENDED | APPROVED: |
|---|---|---|
| R M Hanna<br>ENGINEER | E Sullivan<br>LT COL CORPS OF ENGINEERS | COL CORPS OF ENGRS<br>DISTRICT ENGINEER |

| DRAWN BY: J.E.K<br>CHECKED BY | QC-A-2/1<br>FILE NO. | TRANSMITTED WITH LETTER OF<br>DATED |
|---|---|---|

PLATE III

## LOCATION OF DRILL HOLES

## POINT ROCKWAY CANAL

| Hole No. | Mercator Coordinates | |
|---|---|---|
| | North | East |
| D-1072 | 1,763,222 | 254,573 |
| D-1073 | 1,767,440 | 257,710 |
| D-1263 | 1,768,466 | 258,311 |
| D-1264 | 1,768,155 | 258,495 |
| D-1265 | 1,768,040 | 258,720 |
| D-1269 | 1,767,160 | 258,250 |
| D-1270 | 1,767,275 | 258,035 |
| D-1276 | 1,766,400 | 257,570 |
| D-1277 | 1,766,290 | 257,780 |
| D-1280 | 1,769,150 | 258,740 |
| D-1281 | 1,769,035 | 258,970 |
| D-1282 | 1,762,945 | 253,650 |
| D-1283 | 1,762,290 | 253,810 |
| D-1284 | 1,761,900 | 252,900 |
| D-1285 | 1,761,365 | 252,060 |
| D-1286 | 1,759,952 | 249,752 |
| D-1287 | 1,759,141 | 248,665 |
| D-1288 | 1,759,626 | 248,801 |
| D-1338 | 1,767,487 | 257,658 |
| D-1339 | 1,764,745 | 256,422 |
| D-1340 | 1,763,699 | 255,835 |
| D-1341 | 1,762,726 | 254,678 |
| D-1343 | 1,761,782 | 253,146 |
| D-1345 | 1,760,052 | 250,336 |
| D-1376 | 1,760,838 | 251,613 |
| D-1378 | 1,761,632 | 252,480 |
| D-1379 | 1,762,631 | 253,680 |

## LOCATION OF SEISMIC LINES

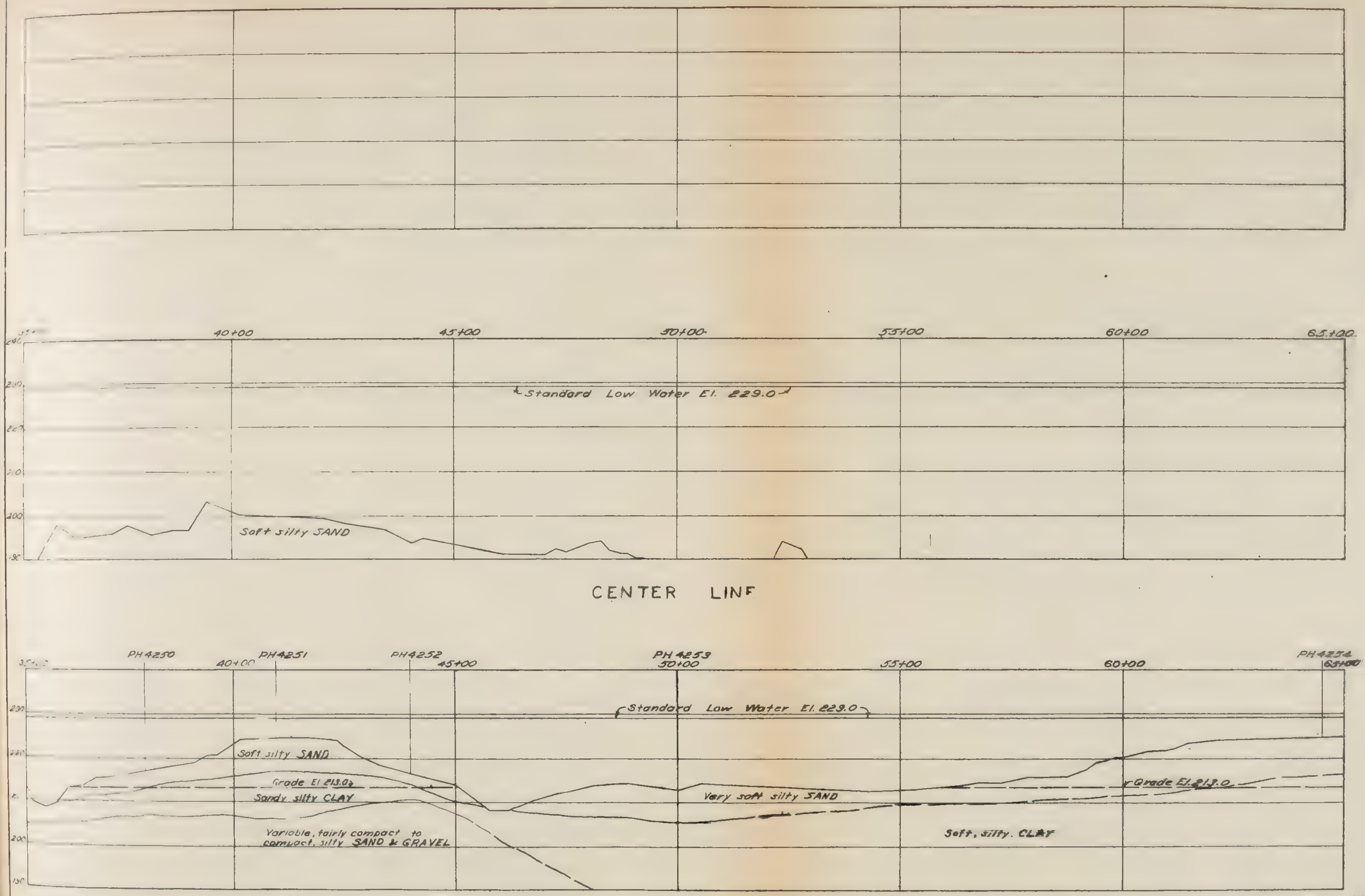
## POINT ROCKWAY CANAL

| Line No. | Mercator Coordinates | | Surface elevation at center point | Rock Elevation |
|---|---|---|---|---|
| | N. | E. | | |
| 50 | 1,760,508 | 249,891 | 231.5 | 206.5 |
| 53 | 1,760,762 | 250,196 | 241.6 | 215.0 |
| 54 | 1,760,526 | 250,553 | 232.4 | 207.0 |
| 55 | 1,762,337 | 249,072 | 266.3 | 203.7 |
| 88 | 1,768,168 | 258,368 | 228.5 | 201.7 |
| 89 | 1,767,416 | 257,823 | 229.5 | 199.5 |
| 90 | 1,766,548 | 257,326 | 230.3 | 195.3 |
| 97 | 1,765,104 | 256,218 | 233.2 | 199.2 |
| 114 | 1,763,511 | 255,138 | 240.1 | 201.1 |
| 115 | 1,762,976 | 253,813 | 241.5 | 226.0 |
| 116 | 1,762,331 | 252,494 | 235.8 | 178.8 |
| 164 | 1,769,065 | 258,995 | 228.0 | 206.9 |
| 165 | 1,767,861 | 259,062 | 246.7 | 207.0 |
| 166 | 1,768,595 | 258,008 | 234.7 | 211.2 |
| 167 | 1,767,568 | 257,089 | 244.5 | 207.8 |
| 168 | 1,765,185 | 255,445 | 268.3 | 192.3 |
| 169 | 1,766,083 | 256,601 | 233.4 | 195.5 |
| 170 | 1,765,389 | 257,018 | 233.1 | 200.6 |
| 171 | 1,765,641 | 257,772 | 241.7 | 220.3 |
| 172 | 1,763,146 | 255,952 | 231.1 | 205.8 |
| 173 | 1,763,998 | 256,721 | 236.0 | 222.7 |
| 174 | 1,762,614 | 254,807 | 243.8 | 206.9 |
| 175 | 1,762,305 | 253,898 | 241.1 | 232.1 |
| 176 | 1,761.814 | 253,036 | 239.8 | 219.5(234.5)* |
| 177 | 1,760,188 | 250,652 | 231.5 | 212.9 |
| 178 | 1,760,570 | 251,563 | 234.4 | 204.1 |
| 179 | 1,761,263 | 252,369 | 234.8 | 222.4 |
| 209 | 1,759,918 | 250,122 | 231.9 | 204.6 |
| 210 | 1,760,526 | 250,350 | 232.6 | 204.4 |
| 211 | 1,759,877 | 250,498 | 247.0 | 213.0 |
| 212 | 1,760,360 | 251,180 | 233.0 | 210.2 |
| 213 | 1,760,322 | 251,802 | 238.0 | 203.8 |
| 214 | 1,760,020 | 252,090 | 245.0 | 226.2 |
| 315 | 1,763,207 | 255,439 | 237.0 | 208.2 |
| 316 | 1,763,229 | 255,073 | 239.9 | 210.5 |
| 317 | 1,762,915 | 254,562 | 239.4 | 218.4 |
| 318 | 1,762,726 | 254,678 | 240.1 | 205.8 |
| 319 | 1,762,945 | 254,191 | 237.9 | 224.3(230.9)* |
| 320 | 1,762,631 | 253,680 | 237.1 | 222.5(232.6)* |
| 321 | 1,762,316 | 253,169 | 235.3 | 198.5 |
| 322 | 1,762,128 | 253,285 | 238.2 | 232.4 |
| 323 | 1,761,782 | 253,146 | 244.6 | 223.9(240.3)* |
| 324 | 1,762,001 | 252,658 | 234.3 | 218.0 |
| 325 | 1,761,656 | 252,519 | 233.2 | 226.5(229.5)* |
| 326 | 1,764,481 | 256,280 | 230.1 | 224.1 |
| 327 | 1,764,058 | 255,800 | 238.3 | 230.2 |
| 328 | 1,763,953 | 255,995 | 233.6 | 223.1 |
| 329 | 1,763,848 | 256,190 | 233.3 | 217.0 |
| 330 | 1,764,586 | 256,085 | 238.2 | 215.0 |
| 331 | 1,764,376 | 256,474 | 236.7 | 213.9 |
| 332 | 1,764,904 | 256,759 | 235.1 | 212.9 |
| 333 | 1,765,014 | 256,355 | 229.6 | 206.4 |
| 381 | 1,769,202 | 258,901 | 237.6 | 191.2 |
| 392 | 1,769,465 | 259,004 | 225.1 | 180.0 |

*Due to the overburden and bedrock conditions in this area, the interpretation of the seismic data is uncertain. Figures in parentheses are the probable surface elevation of slightly fractured and weathered bedrock. Figures not in parentheses are the probable **elevation of sound bedrock.**

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



CENTER LINE

SOUTH SIDE

421' South

SCALE: 1"=100' HORIZONTAL
1"=10' VERTICAL

ST. LAWRENCE RIVER PROJECT

POINT ROCKWAY CANAL

GEOLOGICAL PROFILES

STA. 35+00 TO STA. 65+00

SCALE AS SHOWN

U. S. ENGINEER OFFICE, MASSENA, NEW YORK, FEBRUARY 1942

R. M. Haines

LT COL

DRAWN BY: JEX

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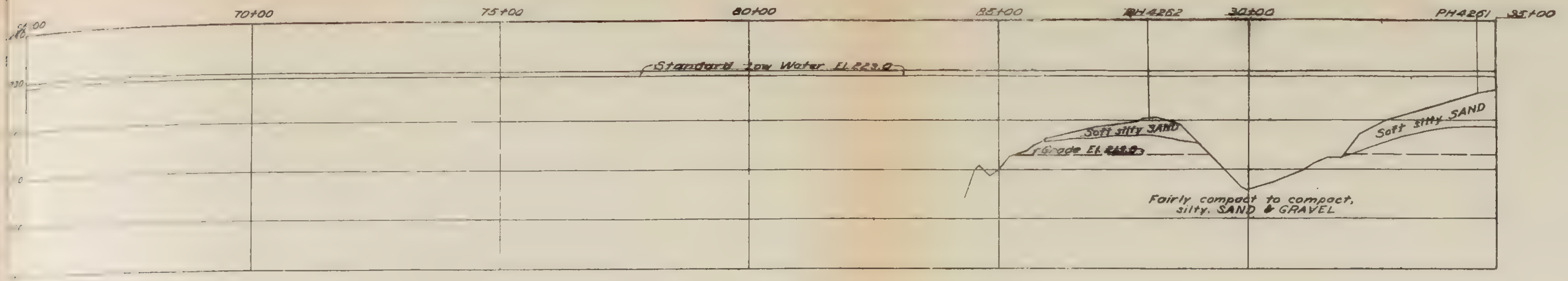
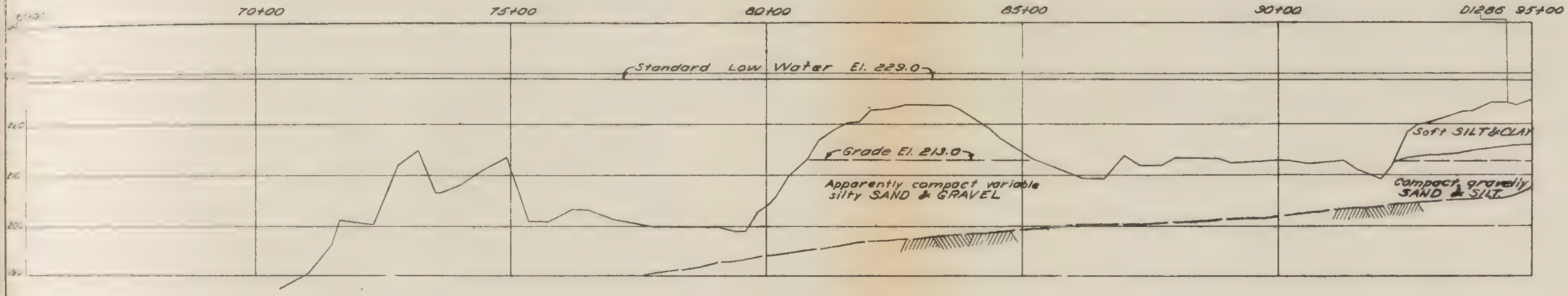
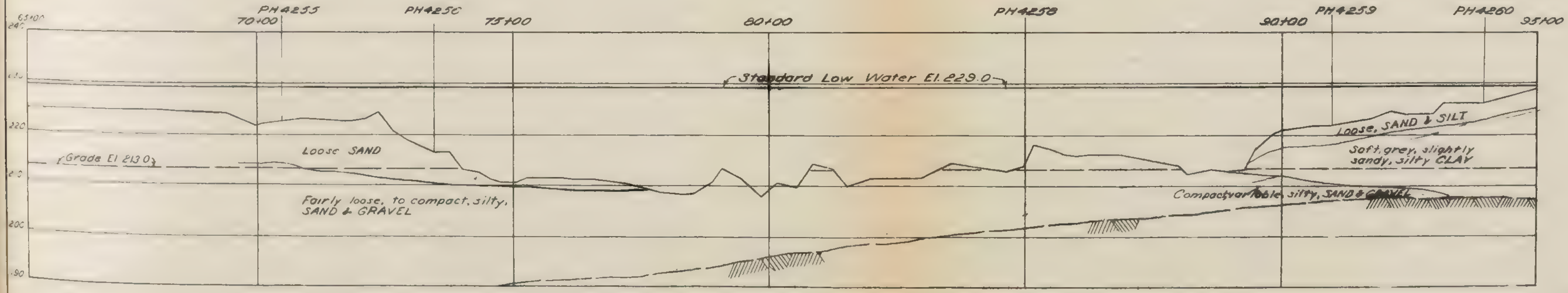
PLATE [illegible]



NORTH SIDE


70+00
75+00
80+00
85+00
90+00
D1286
95+00
Standard Low Water El. 229.0
Grade El. 213.0
Apparently compact variable silty SAND & GRAVEL
Soft SILT & CLAY
Compact gravelly SAND & SILT
220
210
200
190

CENTER LINE


PH4255
70+00
PH4256
75+00
80+00
PH4258
90+00
PH4259
PH4260
95+00
Standard Low Water El. 229.0
Grade El 213.0
Loose SAND
Fairly loose, to compact, silty, SAND & GRAVEL
Loose, SAND & SILT
Soft, grey, slightly sandy, silty CLAY
Compact variable silty, SAND & GRAVEL
220
210
200
190

SOUTH SIDE

421' South

SCALE: 1" = 100' HORIZONTAL
1" = 10' VERTICAL

ST. LAWRENCE RIVER PROJECT

~~POINT~~ ROCKWAY CANAL

GEOLOGICAL PROFILES

STA. 65+00 TO STA. 95+00

IN SHEETS SHEET NO. SCALE AS SHOWN

U. S. ENGINEER OFFICE, MASSENA, NEW YORK, FEB. 1942

SUBMITTED: R. M. Harris

RECOMMENDED:

LT. COL. CORPS OF ENGINEERS

APPROVED:

DRAWN BY: J.E.K.

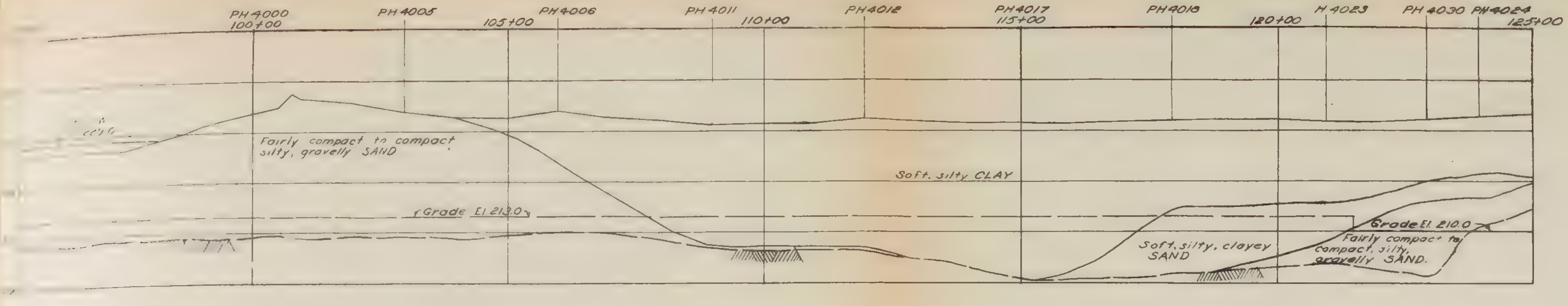
CHECKED BY:

FILE NO.

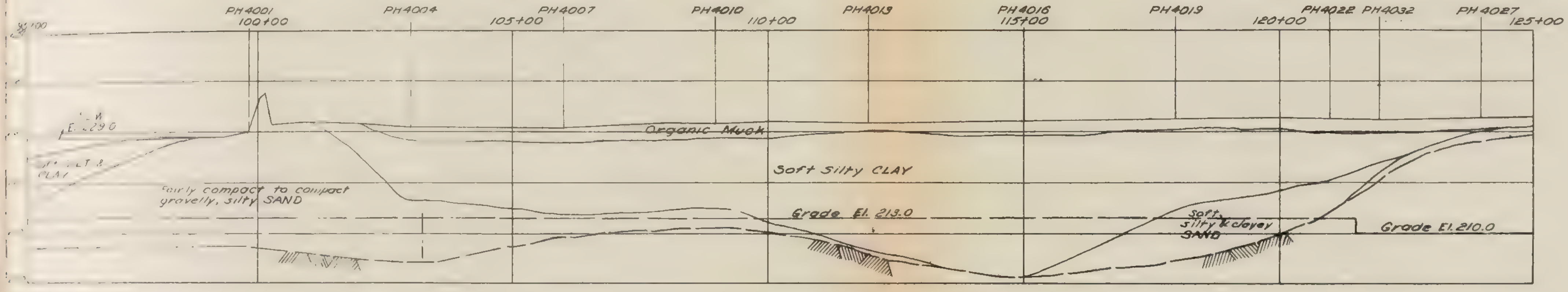
TRANSMITTED WITH LETTER OF

DATED

PLATE IV-2



NORTH SIDE
221' North



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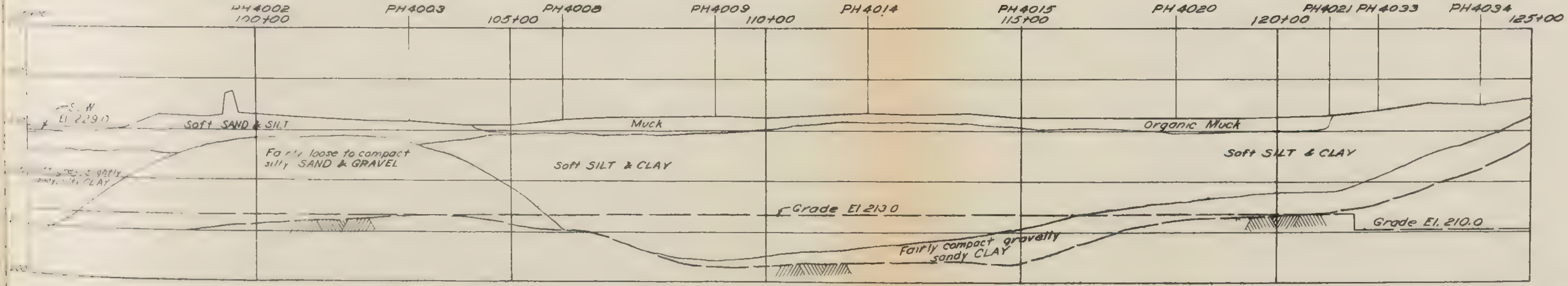

SOUTH SIDE
221' South

SCALE: 1"=100' HORIZONTAL
1"=10' VERTICAL

ST. LAWRENCE RIVER PROJECT
POINT ROCKWAY CANAL
GEOLOGICAL PROFILES
STA. 95+00 TO STA. 125+00

IN SHEETS SHEET NO. SCALE: AS SHOWN

U. S. ENGINEER OFFICE, MASSENA, NEW YORK, FEB. 1942

| SUBMITTED: | RECOMMENDED: | APPROVED: |
|---|---|---|
| R. M. Hansen<br>ENGINEER | HEAD ENGR.<br>LT. COL. CORPS OF ENGINEERS | COL. CORPS OF ENGINEERS<br>DISTRICT ENGINEER |

| DRAWN BY: JEY<br>CHECKED BY: | FILE NO.<br>QCA-2/4 | TRANSMITTED WITH LETTER OR ENDORSEMENT<br>DATED 1941 |
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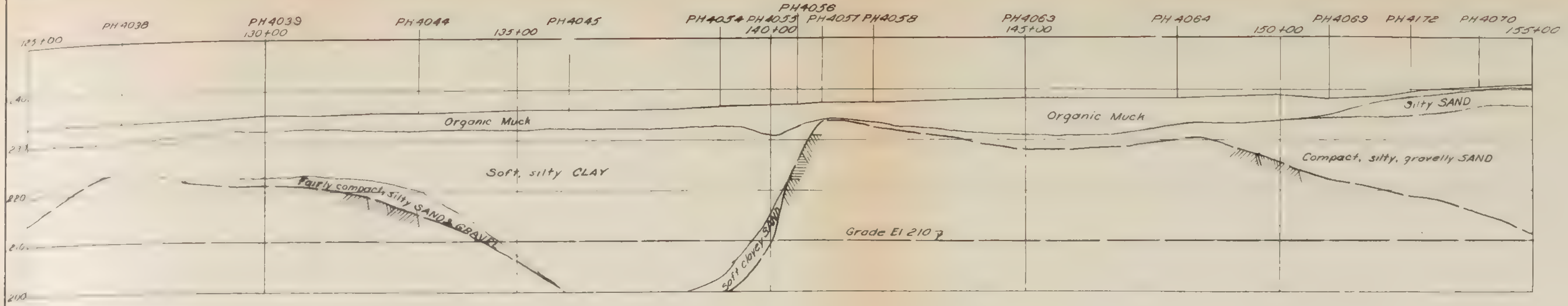
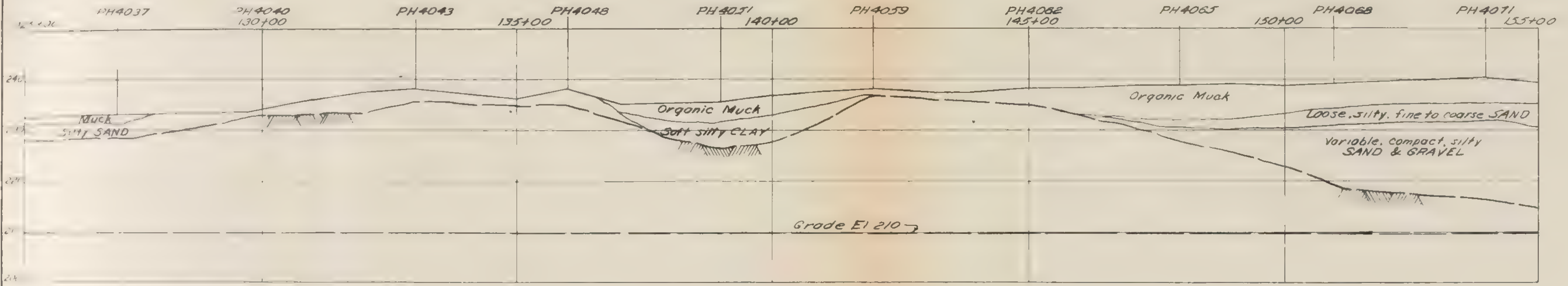
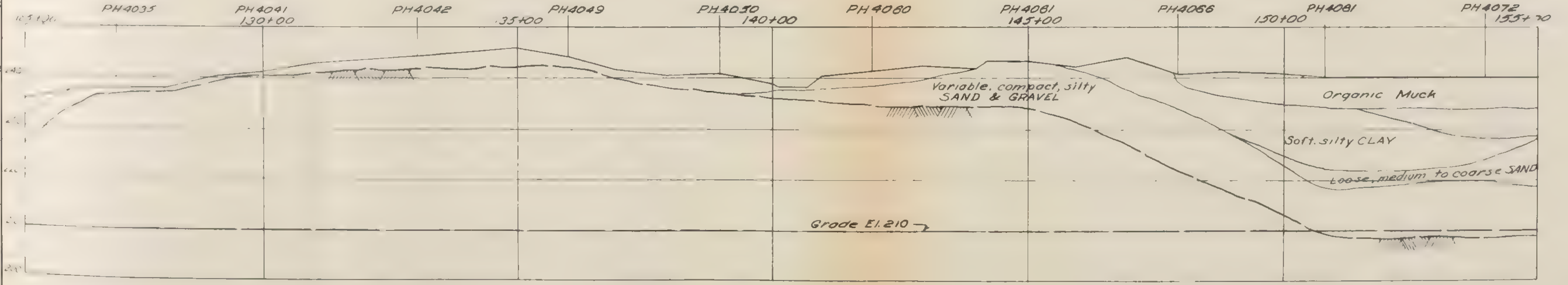
PLATE IV



## NORTH SIDE
221' North



## CENTER LINE



## SOUTH SIDE
221' South

SCALE 1" = 100' HORIZONTAL
1" = 10' VERTICAL

ST. LAWRENCE RIVER PROJECT
POINT ROCKWAY CANAL
GEOLOGICAL PROFILES
STA. 125+00 TO STA 155+00

IN SHEETS SHEET NO SCALE AS SHOWN

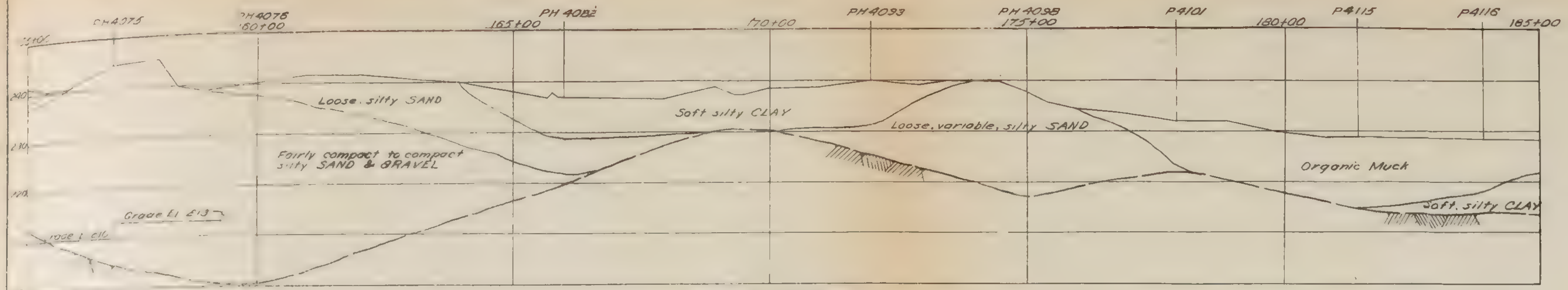
U S ENGINEER OFFICE, MASSENA, NEW YORK. FEB, 1942

SUBMITTED R M Hanes ENGINEER

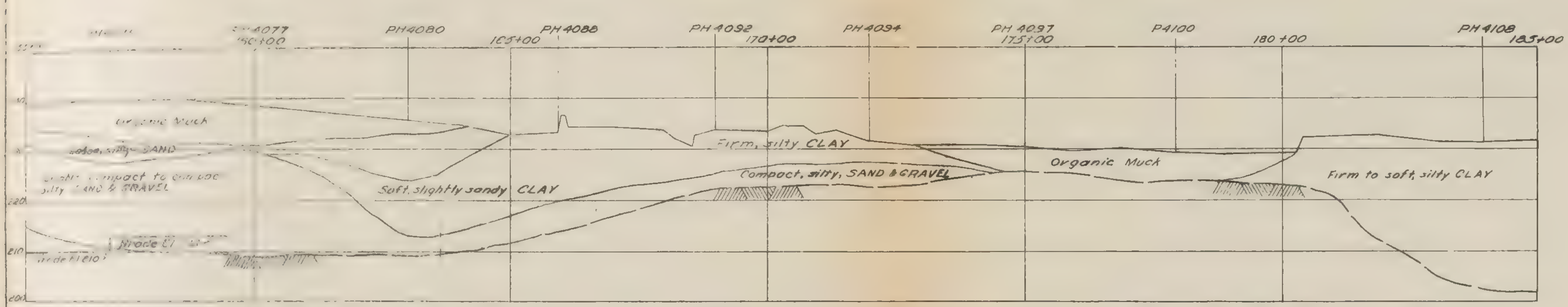
RECOMMENDED HEAD ENGR
LT COL CORPS OF ENGINEERS

APPROVED
COL CORPS OF ENGINEERS DISTRICT ENGINEER

DRAWN BY JEI
CHECKED BY
FILE NO QC-A-2/5
TRANSMITTED WITH LETTER OR ENDORSEMENT
DATED 194



NORTH SIDE
221' North



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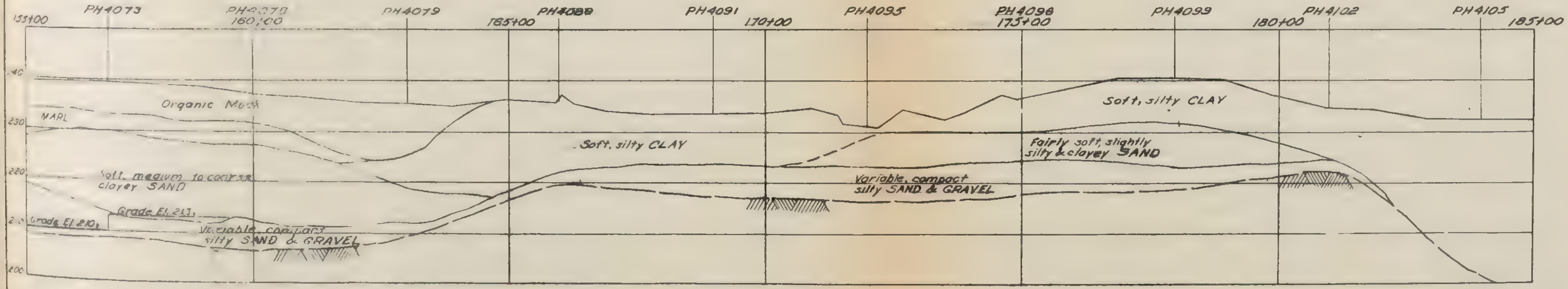

SOUTH SIDE
221' South

SCALE: 1"=100' HORIZONTAL
1"=10' VERTICAL

ST. LAWRENCE RIVER PROJECT
POINT ROCKWAY CANAL
GEOLOGICAL PROFILES
STA. 155+00 TO STA. 185+00

IN SHEETS SHEET NO. SCALE: AS SHOWN

U. S. ENGINEER OFFICE, MASSENA, NEW YORK, FEB. 1942

SUBMITTED: R. M. Hames ENGINEER

RECOMMENDED: HEAD ENGR.
L T COL CORPS OF ENGINEERS

APPROVED:
COL. CORPS OF ENGINEERS DISTRICT ENGINEER

DRAWN BY: JEY
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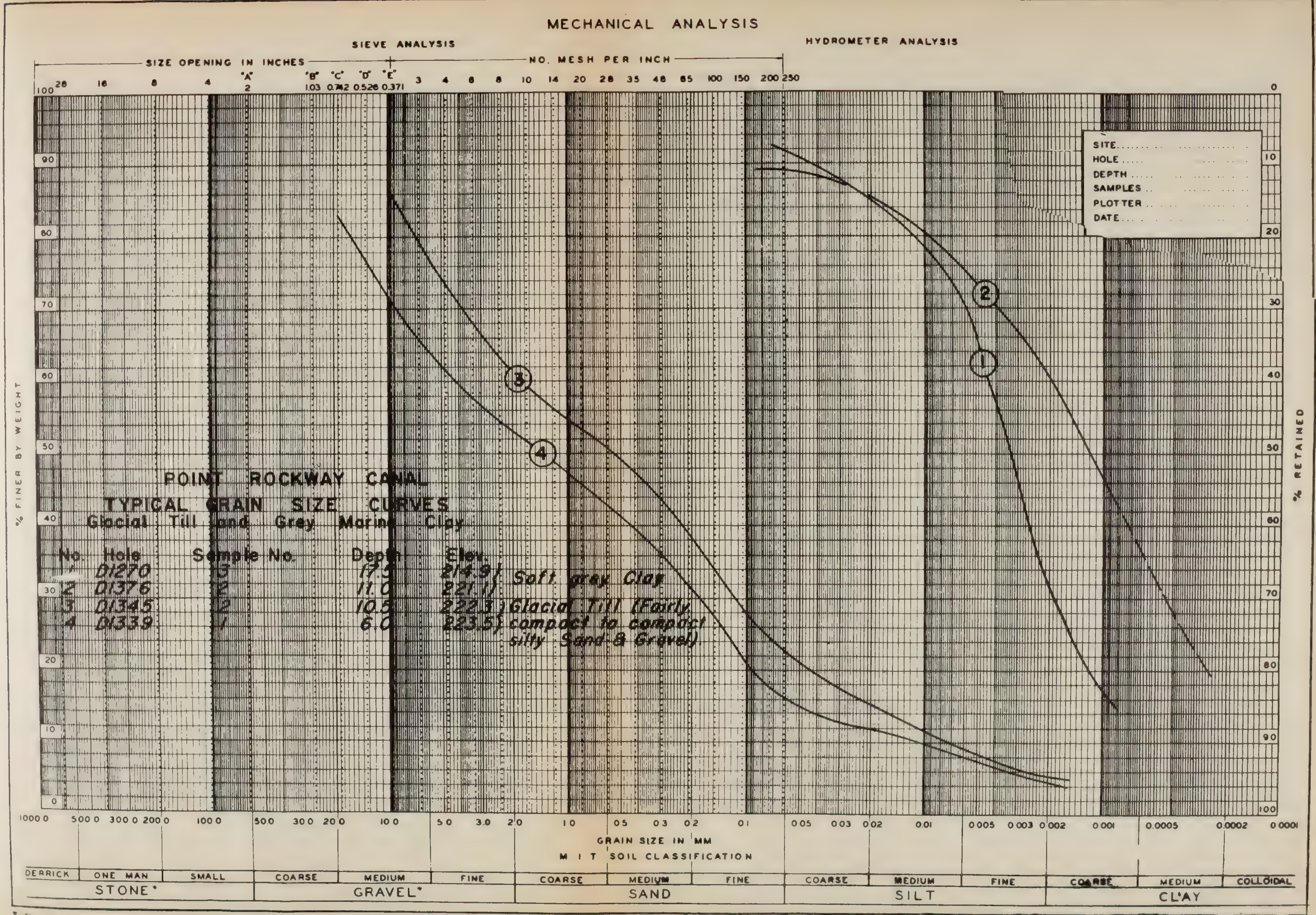
FILE NO. QC-A-2/6

TRANSMITTED WITH LETTER OR ENDORSEMENT
DATED 1941

WAR DEPARTMENT CORPS OF ENGINEERS


MECHANICAL ANALYSIS

POINT ROCKWAY CANAL

TYPICAL GRAIN SIZE CURVES

Glacial Till and Grey Marine Clay

| No. | Hole | Sample No. | Depth | Elev. | |
|---|---|---|---|---|---|
| 1 | D1270 | 3 | 17.5 | 214.9 | Soft grey Clay |
| 2 | D1376 | 2 | 11.0 | 221.1 | |
| 3 | D1345 | 2 | 10.5 | 222.3 | Glacial Till (Fairly compact to compact silty Sand & Gravel) |
| 4 | D1339 | 1 | 6.0 | 223.5 | |

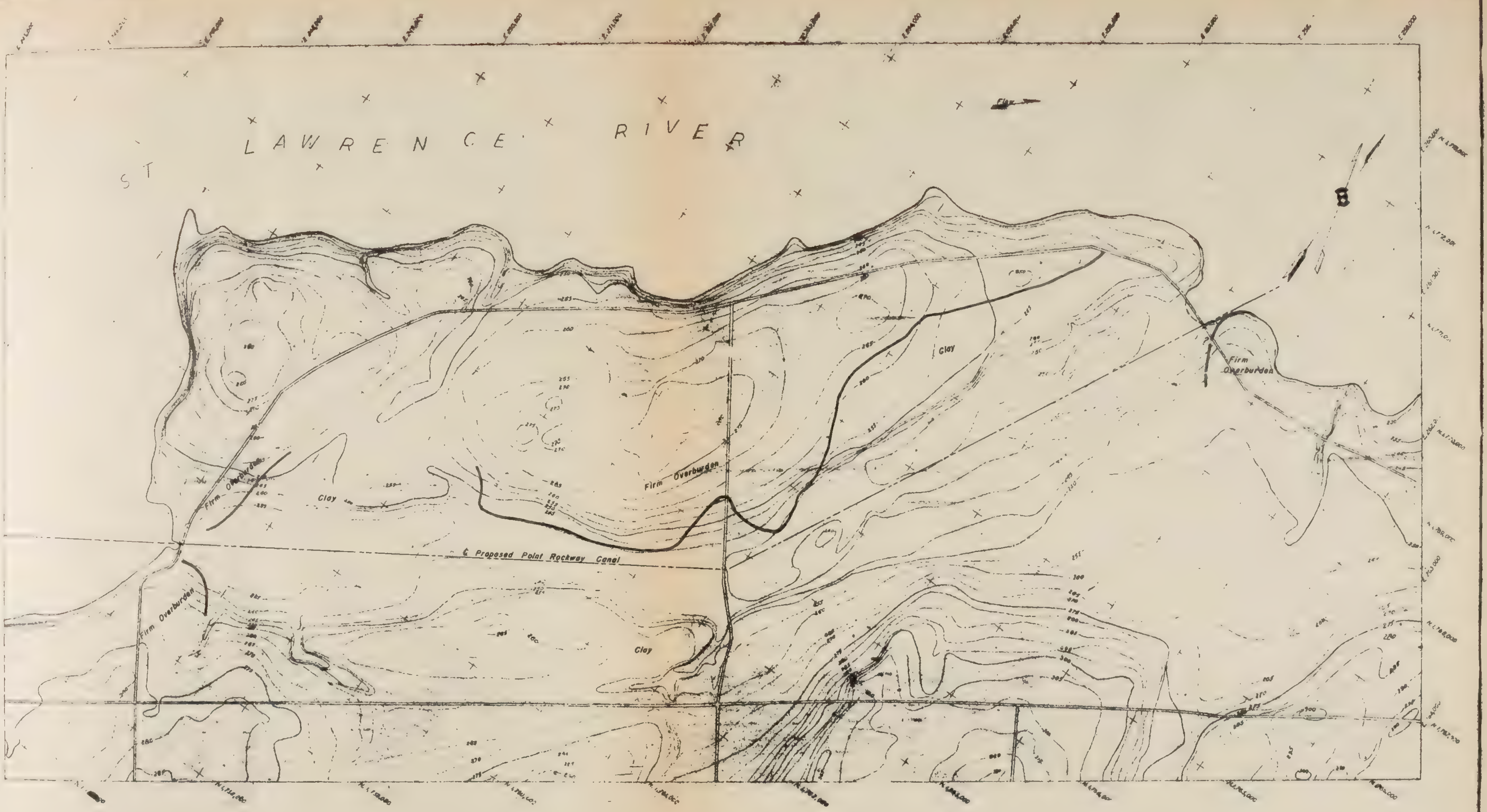
* These sizes not included in original M.I.T. Classification

FILE NO. QC-A-2/7. PLATE IV-6

SL-5.00

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



ST. LAWRENCE RIVER PROJECT
## POINT ROCKWAY CANAL
SOILS CONDITION IN VICINITY OF SPOIL AREAS
SOILS & FOUNDATION EXPLORATION

IN SHEETS SHEET NO. SCALE

500 0 500 1000

U. S. ENGINEER OFFICE, MASSENA, NEW YORK FEBRUARY, 1942

SUBMITTED R. W. Hamm

RECOMMENDED

LT. COL. CORPS OF ENGINEERS

FILE NO. QC-A-2/3

PLATE IV-7

# PART THREE

# IROQUOIS DAM

## ESTIMATE OF COST

## IROQUOIS DAM

### Estimate of Cost - March 18, 1942

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### SUMMARY

---

| | | |
|---|---|---|
| 1. | General Contract | $7,956,482 |
| 2. | Materials & Equipment | 5,650,660 |
| | | $13,607,142 |
| 3. | Engineering & Contingencies 18%± | 2,449,858 |
| | Total Cost | $16,057,000 |

# IROQUOIS DAM

## Estimate of Cost - March 18, 1942

## Bid Items

| Item No. | Designation | Unit | Quantity | Unit Price $ | Amount $ |
|---|---|---|---|---|---|
| 1 | Excavation; Cofferdam | Cu.Yd. | 107,400 | 2.50 | 268,500 |
| 2 | Timber Cribs in Place | M.B.M. | 6,800 | 100.00 | 680,000 |
| 3 | Crib Sheating (Bulkheads) | Sq.Ft. | 16,000 | .75 | 12,000 |
| 4 | Steel Sheet Piling in Place | "   " | 64,300 | 1.50 | 96,450 |
| 5 | Crib Fill | Cu.Yd. | 155,200 | 1.50 | 232,800 |
| 6 | Earth Fill; Cofferdams | "   " | 298,500 | .50 | 149,250 |
| 7 | Rock Fill; Cofferdams | "   " | 106,700 | 2.50 | 266,750 |
| 8 | Riprap; Cofferdams | "   " | 20,800 | 2.00 | 41,600 |
| 9 | Derrick Stone; Cofferdams | Ton | 5,000 | 5.00 | 25,000 |
| 10 | Cofferdam Removal | Cu.Yd. | 569,000 | .50 | 284,500 |
| 11 | Unwatering Cofferdams | AcreFt. | 25,000 | 6.00 | 150,000 |
| 12 | Excavation; Common, Dam | Cu.Yd. | 657,200 | .50 | 328,600 |
| 13 | Excavation; Rock, Dam | "   " | 32,000 | 2.00 | 64,000 |
| 14 | Excavation; Borrow | "   " | 100,000 | .30 | 30,000 |
| 15 | Excavation; Common, Canal | "   " | 2,412,000 | .32 | 771,840 |
| 16 | Excavation; Rock, Canal | "   " | 928,000 | 1.75 | 1,624,000 |
| 17 | Line Drilling | Sq.Ft. | 45,000 | 1.00 | 45,000 |
| 18 | Drilling 3" Exploratory Holes | Lin.Ft. | 15,000 | 5.00 | 75,000 |
| 19 | Drilling 6" Concrete Cores | "   " | 1,000 | 10.00 | 10,000 |
| 20 | Drilling Foundation Grout Holes in Rock | "   " | 10,000 | 5.00 | 50,000 |

| Item No. | Designation | Unit | Quantity | Unit Price $ | Amount $ |
|---|---|---|---|---|---|
| 21 | Drilling Foundation Grout Holes in Concrete | Lin.Ft. | 2,000 | 2.50 | 5,000 |
| 22 | Core Boxes | Each | 200 | 2.00 | 400 |
| 23 | Providing Pressure Grouting Equipment | Sum | Job | | 5,000 |
| 24 | Pressure Grouting | Cu.Ft. | 10,000 | 1.00 | 10,000 |
| 25 | Rock Flour in Grout | " " | 1,500 | .50 | 750 |
| 26 | Sand in Grout | " " | 1,500 | .25 | 375 |
| 27 | Earth Fill; Compacted | Cu.Yd. | 205,000 | .12 | 24,600 |
| 28 | Additional Compaction | Square (100sf) | 50,000 | .02 | 1,000 |
| 29 | Sand & Gravel Backing | Cu.Yd. | 6,500 | 1.75 | 11,375 |
| 30 | Riprap; Dumped, Class A | " " | 6,500 | 3.00 | 19,500 |
| 31 | Riprap; Dumped, Class B | " " | 8,900 | 2.50 | 22,250 |
| 32 | Rock Fill; Random | " " | 50,000 | 2.50 | 125,000 |
| 33 | Rolled Gravel Surface | Sq.Yd. | 23,000 | .50 | 11,500 |
| 34 | Seeded Top Soil | Acre | 2 | 500.00 | 1,000 |
| 35 | Seeding | " | 2 | 250.00 | 500 |
| 36 | Concrete; Class A | Cu.Yd. | 3,500 | 11.00 | 38,500 |
| 37 | Concrete; Class B | " " | 61,000 | 7.00 | 427,000 |
| 38 | Concrete; Class C | " " | 179,000 | 6.00 | 1,074,000 |
| 39 | Concrete Stoplogs | Sum | Job | | 40,000 |
| 40 | Special Bituminous Filler; Type C | Cu.Ft. | 170 | 1.50 | 255 |
| 41 | Steel Erection; Concrete Reinforcing | Lb. | 6,000,000 | .025 | 150,000 |
| 42 | Steel Erection; Structural | " | 6,800,000 | .03 | 204,000 |
| 43 | Steel Rails; Placing | " | 381,000 | .015 | 5,715 |
| 44 | Spillway Gates; Erection | " | 22,600,000 | .02 | 452,000 |
| 45 | Gantry Cranes; Erection | Sum | Job | | 50,000 |
| 46 | Steel Forgings; Miscellaneous | Lb. | 2,500 | .30 | 750 |

| Item No. | Designation | Unit | Quantity | Unit Price $ | Amount $ |
|---|---|---|---|---|---|
| 47 | Steel, Structural; Miscellaneous | Lb. | 5,000 | .18 | 900 |
| 48 | Iron; Cast | " | 20,000 | .16 | 3,200 |
| 49 | Pipe; Cast Iron | " | 39,000 | .15 | 5,850 |
| 50 | Pipe; Wrought Iron | " | 2,000 | .25 | 500 |
| 51 | Pipe; Black Steel | " | 2,000 | .15 | 300 |
| 52 | Pipe; Concrete, Halved | Lin.Ft | 360 | .20 | 72 |
| 53 | Bronze Castings | Lb. | 2,700 | 1.00 | 2,700 |
| 54 | Copper; Sheet | " | 500 | .40 | 200 |
| 55 | Corrugated Iron Water Stop | " | 4,800 | .15 | 720 |
| 56 | Doors; Steel | " | 700 | .20 | 140 |
| 57 | Windows; Steel | " | 3,600 | .20 | 720 |
| 58 | Highway Guard Rail | Lin.Ft | 2,600 | 1.25 | 3,250 |
| 59 | Bridge Guard Rail | " " | 2,600 | 4.00 | 10,400 |
| 60 | Handrailing; Steel Pipe 2" | " " | 9,200 | 3.00 | 27,600 |
| 61 | Handrailing; Steel Pipe 1-1/2" | " " | 300 | 2.50 | 750 |
| 62 | Safety Treads | Lb. | 1,200 | .20 | 240 |
| 63 | Roof Drains | Each | 2 | 50.00 | 100 |
| 64 | Roof Surfacing | Square (100sf) | 4 | 20.00 | 80 |
| 65 | Flagpoles | Each | 2 | 200.00 | 400 |
| 66 | Conduit; Metal | Lb. | 12,000 | .15 | 1,800 |
| 67 | Electric Grounding System | Sum | Job |  | 1,200 |
| 68 | Field Office | " | " |  | 6,500 |
| 69 | Field Office Extension | " | " |  | 3,100 |
|  |  |  | Total Cost |  | $7,956,482 |

# IROQUOIS DAM

## ESTIMATE OF COST - MARCH 18, 1942

### Materials and Equipment Furnished by the Government

| Item No. | Designation | Unit | Quantity | Unit Price $ | Amount $ |
|---|---|---|---|---|---|
| 1 | Fine Aggregate (Crushing Only) | Ton | 160,000 | .75 | 120,000 |
| 2 | Coarse Aggregate (Crushing Only) | " | 342,000 | .40 | 136,800 |
| 3 | Portland Cement | Bbl. | 260,000 | 2.50 | 650,000 |
| 4 | Structural Steel | Lb. | 6,800,000 | .07 | 476,000 |
| 5 | Reinforcing Steel | " | 6,000,000 | .04 | 240,000 |
| 6 | Steel Rails & Accessories | " | 381,000 | .06 | 22,860 |
| 7 | Spillway Gates | " | 22,600,000 | .125 | 2,825,000 |
| 8 | Gantry Cranes | Each | 2 | 175,000 | 350,000 |
| 9 | Cofferdam Timber | M.B.M. | 6,800 | 100.00 | 680,000 |
| 10 | Electrical Contract | Sum | Job | | 100,000 |
| *11 | Miscellaneous Equipment | " | " | | 50,000 |
| | | | Total Cost | | $5,650,660 |

*Includes water supply, ventilating equipment, telephone equipment, gauges, tools, spare parts, supplies, etc.

# ST. LAWRENCE RIVER PROJECT

# FINAL REPORT

1942

DOCUMENTS ROOM

# POINT ROCKWAY LOCK SPECIFICATIONS

CORPS OF ENGINEERS, U.S. ARMY

U.S. ENGINEER OFFICE • MASSENA, NEW YORK.

APPENDIX III-8 (2)

# ST. LAWRENCE RIVER

# PROJECT

* * * * *

## FINAL REPORT

## 1942

# POINT ROCKWAY LOCK

## SPECIFICATIONS

CORPS OF ENGINEERS, U.S. ARMY

U.S. Engineer Office - Massena, New York

July , 1942

APPENDIX III-S (2)

Invitation No. ______

No. Bidder

(Do not write above this line)

## STANDARD GOVERNMENT FORM OF INVITATION FOR BIDS
## (CONSTRUCTION CONTRACT)

WAR DEPARTMENT
UNITED STATES ENGINEER OFFICE
MASSENA, NEW YORK
__________, 1942

1. SEALED BIDS, in duplicate, subject to the conditions contained herein, will be received until 2:00 p.m. E.S.T., _____ and then publicly opened in the United States Engineer Office, Massena, New York, for furnishing all labor, plant, and materials, and performing all work for the construction of Point Rockway Lock, on the Point Rockway Canal, about 3 miles west of the village of Waddington, New York, all as indicated on the drawings or required by the specifications.

2. SPECIFICATIONS AND PLANS.

(a) The work to be done in strict accordance with the specifications and drawings which are designated as follows:

(1) Point Rockway Lock, specifications.

(2) The drawings which will become a part of this contract are designated in paragraph 1-04 of the specifications.

(b) Where copies of drawings are requested, a deposit of twenty-five dollars ($25.00) will be required to insure their return. The deposit should be in the form of a United States money order or a certified check made payable to "The Treasurer of the United States." The deposit will be refunded upon the return of the plans in good condition within 30 days after date of opening bids.

3. INVESTIGATION OF CONDITIONS. - Bidders are expected to visit the locality and site of the work, and to make their own estimates of the facilities needed, and the difficulties attending the execution of the proposed contract, including local conditions, availability of labor, uncertainty of weather, and other contingencies. In no case will the Government assume any responsibility whatever for any interpretation, deduction, or conclusion drawn from the examination of the site. At the bidder's request, a representative of the Government will point out the site of the proposed operation. Failure to acquaint himself with all available information concerning these conditions will not relieve the successful bidder of assuming all responsibilities for estimating the difficulties and costs of successfully performing and completing the work. (See paragraphs 1-17 and 1-19 of the specifications.)

4. WAGE AND LABOR PROVISIONS. - Wage, labor, and anti-discrimination regulations are specified in paragraph 1-38 of the specifications and Articles 11 (Revised), 17, and 19 (Revised) of the contract. Attention of bidders is invited to War Department labor policy for defense construction projects set out in memorandum of agreement approved July 22, 1941. Successful bidders will be expected to adhere to provisions of the agreement, copies of which are on file at Office of District Engineer, U. S. Engineer Office, Massena, N. Y.

5. DOMESTIC PREFERENCE. - Articles on the preference for domestic articles will be made a part of the contract. (See paragraph 1-34 of the specifications.)

6. ARTICLES ON PATENTS will be made a part of the contract. (See paragraph 1-29 of the specifications.)

7. COMMENCEMENT AND COMPLETION. - The work shall be commenced within 20 calendar days after date of receipt of notice to proceed and shall be completed within 900 calendar days after date of receipt of notice to proceed, in accordance with the provisions of paragraph 1-06 of the specifications.

8. Extension of time for completion of construction for delays due to National Defense Priorities will be made. (See Par. 1-06 (e) of the specifications.

9. LIQUIDATED DAMAGES for delay will be prescribed. (See Paragraph 1-06 of the specifications. )

10. PARTIAL PAYMENTS will be made. (See paragraph 1-08 of the specifications and Article 16 of the contract.)

11. ADJUSTMENT OF CONTRACT PRICE by reason of change in Federal, State, and local taxes will be made. (See paragraph 1-41 of the specifications.)

12. ADJUSTMENT OF PRICES FOR LABOR AND MATERIALS. - Adjustment of prices in accordance with the basic increase or decrease of costs of labor and materials will be made as provided in par. 1-45 of the specifications.

13. ESTIMATES OF COST. - Bidders are informed that the Government will prepare estimates of the cost of construction of the work required by the specifications for comparison of bids.

14. REPORTS TO THE DEPARTMENT OF LABOR. - In order to assist the Department of Labor in obtaining employment statistics, bidders, unless otherwise indicated in their bids, will be considered as having voluntarily consented, without cost to the Government, to the inclusion of paragraph 1-38 of the specifications as a part of the contract.

15. Provisions of the Assignment of Claims Act of October 9, 1940 (Public No. 811-76th Congress) will be made a part of the contract. (See paragraph 1-44 of the specifications.

16. BID AND CONTRACT.

(a) Bids must be submitted upon the standard Government form of bid, and the successful bidder will be required to execute the standard Government form of contract for construction (U. S. Standard Form No. 23). Bidders are advised that Article II (a) of U. S. Standard Form No. 23 has been revised to permit laborers and mechanics to work more than 8 hours per day, provided overtime compensation at a rate of not less than 1-1/2 times the basic rate of pay is paid for all working time of each laborer or mechanic in excess of 8 hours in any one day. Also Article 19, Nonrebate of U. S. Standard Form No. 2 is revised to read as follows, and the contract to be entered into as result of this invitation will be altered accordingly:

"ARTICLE 19. Nonrebate. (a) The contractor shall furnish to the Government representative in charge at the site of the work covered by this contract, or if no Government representative is in charge at the site, shall mail to the Federal agency contracting for the work, within 7 days after the regular payment date of each and every weekly pay roll, an affidavit in the form prescribed by regulations issued by the Secretary of Labor and published in the Federal Register of March 1, 1941, 6 F. R. 1211, or any modification thereof pursuant to the act of June 13, 1934, 48 Stat. 948 (U. S. Code title 40, sections 276b and 276c), sworn to by the contractor or the subcontractor concerned or by the authorized officer or employee of the contractor or subcontractor supervising such payment, to the fact that each and every person employed on the work has the affidavit, that no rebates have been or will be made either directly or indirectly to or on behalf of the contractor or such subcontractor from the full weekly wages earned as set out on such payroll; and that no deductions, other than permissible deductions as defined in the said regulations pursuant to said act of June 13, 1934, and as described in said affidavit, have been or will be made, either directly or indirectly, from the full weekly wages earned as set out on such payroll.

"(b) The contractor shall comply with all applicable requirements of the said regulations of the Secretary of Labor under the act of June 13, 1934, and the requirements of this article of the contract shall be subject to all applicable provisions of such regulations.

"(c) The contractor shall cause appropriate provisions to be inserted in all subcontracts relating to this work to insure fulfillment of the requirements of this article."

(b) The bid form has an entry for each item on which estimates will be given or payments made, and no other allowance of any kind will be made unless specifically provided for in the specifications or the contract, or adjustments under Article 3 of the contract.

(c) All bids must be for the entire work and must have each blank filled.

(d) The quantities of each item of the bid as finally ascertained at the close of the contract, in the units given, and the unit prices of the several items stated by the bidder in the accepted bid, will determine the total payments to accrue under the contract. The unit price bid for each item must allow for all collateral or indirect cost connected with it.

17. EXPERIENCE. (a) Each bidder shall state in the space provided in the bidding schedule, a brief description of the character of the work previously executed by him and the locations of the major projects. After the bids are opened, any bidder may be required by the contracting officer to state whether he is now or ever has been engaged on any construction work similar to that proposed, the year in which it was done, and the manner of its execution, and to give such other information as will tend to show his ability to prosecute vigorously the work required by these specifications.

(b) For the manufacture and fabrication of the machinery required under Section XIV, the successful bidder will be required to employ an organization thoroughly experienced in the design and manufacture of machinery and gears of this character. For the installation of the lock gates, segmental valves, pool supply valve, wire rope fenders, emergency dam stop logs and derrick swing bridge, the successful bidder will be required to employ an organization thoroughly experienced and skilled in the fabrication and erection of steel structures requiring a similar high degree of precision and workmanship. After the opening of bids, any bidder may be required by the contracting officer to submit satisfactory evidence that the specific organization which he proposes to employ on this portion of the contract has successfully executed work of the nature and quality indicated above.

18. DATA TO BE SUBMITTED WITH BIDS.

(a) All bids submitted must be accompanied by a statement establishing that the bidder maintains a permanent place of business and has a suitable financial status to meet obligations incident to the work. (See paragraph 3 of the bidding schedule.) In addition, each bidder shall submit with his bid the statement of plant, drawings, charts, and other information and data required below. These data shall be carefully prepared and presented in neat and legible form on tracing paper or tracing cloth so that reproduction may be made therefrom. These data are considered essential in enabling the contracting officer to determine whether the bidder is responsible and experienced in similar types of construction and whether the bid is based on a careful study of construction methods which may affect the progress of the work. Award of this contract shall not be construed as a guarantee by the Government that the materials or supplies listed in the bidding schedule are approved.

(b) Drawings shall be submitted indicating the plant layout the bidder proposes to utilize on the work. The drawings shall clearly indicate the location and manner of employment of the various major items of the plant. They shall include the arrangement of the plant for the handling of materials, and the manner in which excavation and disposal of the excavated materials will be made. They shall also include the location of all material yards and the transportation facilities, as well as the location of the mixing plant and the manner in which concrete will be placed and metal work erected. The plant lay-out shall be accompanied by a complete list and description inserted in the space provided therefor in the bid form, of all plant that the bidder now has or will have available for commencing and prosecuting this work, and its location at the time of opening bids, in order that it may be inspected by the contracting officer should he so desire. The above information will be considered confidential. When a bidder does not own or possess plant and proposes to procure it, firm options on all major items of proposed plant must be submitted when the bids are opened.

(c) A chart or charts shall be submitted indicating the volume of work to be done and the rate of progress which the bidder agrees to maintain (See paragraph 1-19 of the specifications) for each of the following major operations required in the performance of the work under these specifications:

(1) Excavation
(2) Concrete Masonry
(3) Fill and Backfill
(4) Lock Gate Erection
(5) Gate Machinery Installation
(6) Movable Bridge Erection
(7) Embankment Construction North Dike
(8) Embankment Construction South Dike

Charts shall be in the form of plotted curves in which the abscissae shall represent definite intervals of time measured from date of receipt of notice to proceed with the work, and the ordinates shall represent percentages of complet based on the estimated contract quantities. In preparing the charts, due allow shall be made for probable delays caused by any unsatisfactory working conditions. Careful consideration shall be given to the preparation of these charts, as the rate of progress proposed by the accepted bid will be made a part of the contract. (See paragraph 1-19 of the specifications.)

19. AWARD OF CONTRACT.

(a) Subject to the rights hereinafter reserved, work will be awarded as a whole to the lowest responsible bidder whose proposal fully conforms to the requirements of the specifications and as may be deemed most advantageous to the United States.

(b) A bid may be rejected if the bidder fails to furnish bid bond or to submit the data required with his bid or cannot show that he has the necessary capital and experience and owns, controls, or can procure the necessary plant to commence the work at the time prescribed in the specifications and thereafter to prosecute and complete the work at the rate or time specified; and that he is not already obligated for the performance of other work which would delay the commencement, prosecution, or completion of the work contemplated in this advertisement.

(c) Any unbalanced bid which, in the opinion of the contracting officer, jeopardizes the interest of the United States will be subject to rejection for that reason.

(d) The right is reserved, as the interest of the Government may require, to reject any and all bids and to waive any informality in bids received.

(e) Bidders shall indicate whether they intend to use natural sand or crushed stone sand in concrete by placing their unit bid prices in the spaces provided for concrete in the Schedule of Bid Items, opposite the one they intend to use, and shall cross out the other. In the canvass of bids the unit bid prices of bidders who specify using crushed stone sand will be increased by eleven cents ($0.11) for each class of concrete, for the purpose of comparing bids only. This increase is due to the necessity of adding extra cement, furnished by the Government, to concrete made with crushed stone sand.

20. GUARANTY. - Guaranty will be required with each bid as follows: Bid Bond, Standard Form No. 24, will be executed in a penal sum not less than 10 percent of the total amount of the bid, but not exceeding $2,500,000. Individual sureties will justify in sums aggregating not less than double the penalty of the bid bond. (See paragraphs 8 and 9 of the Instructions to Bidders.)

21. PERFORMANCE AND PAYMENT BONDS will be required as follows:

(a) A performance bond with good and sufficient surety or sureties, for the protection of the United States, Standard Form No. 25, will be executed in a penal sum approximately equal to and not less than ten percent (10%) of the full amount of the consideration of the contract, not to exceed two million five hundred thousand dollars ($2,500,000).

(b) If the consideration of the contract will exceed $2,000 in amount, a payment bond with good and sufficient surety or sureties, for the protection of persons furnishing material and labor for the work, Standard Form No. 25-A, will be executed in a penal sum of one-half of the full amount of the consideration of the contract when the latter is not more than one million dollars ($1,000,000); forty percent (40%) where the contract exceeds one million dollars ($1,000,000) but is not more than five million dollars ($5,000,000); and two million five hundred thousand dollars ($2,500,000), for all contracts above five million dollars ($5,000,000).

22. ADDRESS FOR BIDS. - Envelopes containing bids must be sealed, marked, and addressed as follows:

| Mark in upper left hand corner: | Address: |
|---|---|
| Bid for Construction of<br>Point Rockway Lock<br>Invitation No. ____________<br>To be opened at 2:00 p.m., E.S.T.,<br>____________________ | To: The District Engineer<br>U. S. Engineer Office<br>Massena, New York |

Note: See Standard Government Instructions to Bidders and copy of the Standard Government Form of Contract, Bid Bond, Payment Bond, and Performance Bond, which may be obtained upon application.

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U. S. ENGINEER OFFICE
ST. LAWRENCE RIVER DISTRICT
MASSENA, NEW YORK

WAR DEPARTMENT

Appropriation title________________________________________

# SPECIFICATIONS FOR THE CONSTRUCTION OF POINT ROCKWAY LOCK - POINT ROCKWAY CANAL

## SECTION I. GENERAL PROVISIONS

1-01. LOCATION. - The site of the work contemplated by these specifications is in northern New York State, in the County of St. Lawrence, near the International Rapids Section of the St. Lawrence River, about 3 miles west of Waddington, New York, the nearest town. The general location of the site is shown on Sheet No. 2 of the drawings described in paragraph 1-04 of the specifications.

1-02. WORK TO BE DONE.

(a) The work provided herein is authorized by__________________ Act, approved___________________,194 .

(b) The work to be done under this contract and in accordance with these specifications consists of furnishing all plant, superintendence, labor and materials, except as noted in paragraph 1-10, and performing all work required for the construction of the Point Rockway Lock, except for specifically excepted items, with appurtenant works, complete in accordance with the drawings and these specifications. The main features of the work are as follows:

(1) Excavation for navigation channels and for foundations of concrete structures including Foundation Preparation and Grouting, and Excavation of a canal above the lock. (See Section II.)

(2) Placing concrete, reinforcement, and embedded parts for lock. (See Section VI).

(3) Erection and installation of lock gates and operating machinery, emergency dam stop logs and handling derricks, wire rope fenders, a movable bridge, and permanent unwatering pumps. (See Section XVII.)

(4) Placing fill and back fill adjacent to lock walls. (See Section III.)

(5) Construction of earth embankments - North and South Dikes. (See Section III.)

(6) Construction of a highway.

(7) Miscellaneous items including embedded electrical conduit system and other work as specified or shown on the drawings, and such incidental work as may be needed or ordered in writing by the contracting officer.

1-03. DESCRIPTION. - The completed work at this site will provide a navigation lock having usable chamber dimensions of 80 ft. width by 800 ft. length, a minimum depth of 30 ft. of water over gate and emergency dam sills, a maximum lift of about 5 ft. A guide wall approximately 1200 ft. long and wing wall approximately 400 ft. long will be provided at both the upper and lower approaches to the lock. All lock walls will be of concrete, gravity-type section. All lock walls will be founded on rock and will have an average height of about 57 ft. The lock walls will be backed with fill and will be connected at the upper end of the lock chamber by dike embankments to a natural ridge on each side of the canal.

A highway will be provided on top of these connecting dikes and will cross the upper end of the lock on a moveable bridge.

### 1-04. MAPS AND DRAWINGS.

(a) The work shall conform to maps and drawings marked "St. Lawrence River Project, Point Rockway Lock", title and file marked as listed below, which form a part of these specifications and which are filed in the U. S. Engineer Office, St. Lawrence River District, Massena New York.

LIST OF DRAWINGS - POINT ROCKWAY LOCK

| Sheet No. | File No. | Title |
|---|---|---|
| 1 | QL-1-0/1 | Index |
| 2 | 1/1 | Project Location Map |
| 3 | 1/2 | Site Map |
| 4 | 1/3 | General Plan |
| 5 | 2/1 | Plan of Exploration |
| 6 | 2/2 | Plan of Exploration |
| 7 | 2/3 | Record of Exploration |
| 8 | 2/4 | Record of Exploration |
| 9 | 2/5 | Record of Exploration |
| 10 | 2/6 | Record of Exploration |
| | | LOCK WALLS |
| 11 | 15/A | Stability Analyses |
| 12 | 15/1 | Masonry - Upper End - Plan and Sections |
| 13 | 15/2 | Masonry - Lower End - Plan and Sections |
| 14 | 15/3 | Details - Miscellaneous Metal Parts |
| | | EMBANKMENT |
| 15 | 20/2 | Profile and Section |
| | | LOCK GATES |
| 16 | 50/1 | General Drawing |
| 17 | 50/2 | Details |
| | | LOCK GATE OPERATING MACHINERY |
| 18 | 55/1 | Assembly Drawing |
| | | SWING BRIDGE |
| 19 | 90/1 | General Outline and Stress Diagrams |
| 20 | 90/2 | Bridge Supports and Machinery Layout |
| | | WIRE ROPE FENDER |
| 21 | 95/1 | Boom Assembly |
| 22 | 95/2 | Operating Machinery Assembly |
| 23 | 95/3 | Friction Brakes |

24 95/4 Coupling Pin Operating Machinery

## EMERGENCY DAMS

25 QL-1-105/1 General Drawings
26 105/2 Stop Logs - Type A
27 105/3 Stop Logs - Type B and C
28 105/4 Stop Log Pickup Boom

## TEMPORARY CONSTRUCTION

29 160/1 Field Office - Plans and Elevations
30 160/2 Field Office - Utilities

## ACCESS HIGHWAY

31 185/1 Plan and Profile
32 185/2 Typical Highway Sections
33 185/3 Typical Highway Details

## CANAL EXCAVATION

34 190/1 Plan Station 140+00 to Sta. 190+00
35 190/2 Cross Sections

(b) These drawings show the work with as much detail as is possible in the present stage of development of the design. The work shall conform to such other drawings and addenda relating thereto as may be published and/or exhibited in the office of the contracting officer prior to the opening of proposals, and to such drawings in explanation of details as may be required from time to time during construction, including such modifications as the contracting officer may consider necessary on account of conditions that are found to exist during the prosecution of the work. Detail bar lists and bending schedules for steel reinforcement will be furnished by the United States.

(c) Prior to the execution of the work the contractor shall check all drawings and shall immediately report to the contracting officer any errors or omissions discovered therein. Errors and/or omissions in drawings will not relieve the contractor of his responsibility for the correct fitting together and exact position of all parts of the work in accordance with the specifications. Parts and details not fully indicated on the drawings shall be detailed by the contractor in accordance with the best practice, or as directed by the contracting officer. The contractor shall submit fabricator's shop drawings of all structural steel and other metal work for approval. He shall also submit such shop drawings for all equipment specified herein to be designed, as well as furnished and installed, by the contractor, the contractor shall submit such design computation and material lists of all mechanical and electrical equipment as may be required by the contracting officer. No material shall be furnished or work done thereon prior to approval of these drawings. The contractor shall submit three (3) prints of each of such detailed drawings to the contracting officer who will return one print with his approval or notations of such changes as he finds necessary. Each print submitted for approval shall have in the lower right-hand corner just above the title a white space 3 inches by 4 inches in size in which the contracting officer will indicate the action taken. After approval, the contractor shall furnish the contracting officer one tracing and five prints of each approved drawing. Three copies or sets of parts catalogs, spare parts lists and operating instructions shall be furnished as specified above or as requested by the contracting officer. Payment for the contractor's drawings, including revisions hereof, parts catalogs, spare parts lists and operating instructions shall be included in the contract prices paid for material or work. All of these items will form a part of the contract when approved by the contracting officer.

(d) Ten sets of prints of necessary contract drawings (one-half size reproductions, or full size if desired) and twenty sets of specifications will be furnished the contractor without charge. Additional prints may be secured upon request at the cost of reproduction.

1-05. QUANTITIES. - The following estimate of quantities of work to be performed, as also shown in the "Schedule of Bid Items" under these specifications, is given only to serve as a basis for canvassing bids and for determining the approximate amount of the consideration of the contract. Unless the contract is terminated by the failure of Congress to appropriate additional funds (see paragraph 1-08), the contractor will be required to complete the work specified in paragraph 1-02 hereof, be the required quantities more or less than the amounts shown.

| Item No. | Designation | Unit | Quantity |
|---|---|---|---|
| 1 | Excavation; Common | C.Y. | 3,138,000 |
| 2 | Excavation; Borrow | C.Y. | 450,000 |
| 3 | Excavation; Rock | C.Y. | 516,000 |
| 4 | Earth Fill; Compacted, Class "I" | C.Y. | 67,000 |
| 5 | Earth Fill; Compacted Class "II" | C.Y. | 675,000 |
| 6 | Line Drilling | S.F. | 21,000 |
| 7 | Filter | C.Y. | None |
| 8 | Sand and Gravel Backing | C.Y. | 6,900 |
| 9 | Riprap; Dumped, Class "A" | C.Y. | 19,100 |
| 10 | Riprap; Dumped, Class "B" | C.Y. | 29,900 |
| 11 | Drilling; Grout Holes in Concrete | Lin.Ft. | 1,100 |
| 12 | Drilling; Grout Holes in Rock, 0 to 25 feet | Lin.Ft. | 2,400 |
| 13 | Drilling; Grout Holes in Rock, 25 feet or over | Lin.Ft. | 750 |
| 14 | Drilling; Exploratory Holes in Rock, 0 to 25 feet | Lin.Ft. | 1,800 |
| 15 | Drilling; Exploratory Holes in Rock, 25 to 50 feet | Lin.Ft. | 400 |
| 16 | Drilling; Exploratory Holes in Rock, 50 to 100 feet | Lin.Ft. | 400 |
| 17 | Pressure Grouting | Cu.Ft. | 4,000 |
| 18 | Sand in Grout | Cu.Ft. | 300 |
| 19 | Rock Flour in Grout | Cu.Ft. | 300 |
| 20 | Timber; White Oak | M.F.B.M. | 34.5 |
| 21 | Timber; Common (Creosoted) | M.F.B.M. | 15.1 |
| 22 | Concrete; Class "A" (Natural Sand<br>(Crushed Stone<br>(Sand | C.Y. | 1,050 |

| Item No. | Designation (Cont'd) | Unit | Quantity |
|---|---|---|---|
| 23 | Concrete; Class "B" (Natural Sand<br>(Crushed Stone<br>(Sand | C.Y. | 271,500 |
| 24 | Steel; Structural, Sector Gates, Movable Parts | Pound | 2,416,000 |
| 25 | Floor Plating; Steel | S.F. | 6,500 |
| 26 | Steel; Structural, Stop Logs | Pound | 1,104,000 |
| 27 | Steel; Structural, Miscellaneous | Pound | 685,000 |
| 28 | Steel Erection; Concrete Reinforcement | Pound | 600,000 |
| 29 | Forgings; Steel | Pound | 90,000 |
| 30 | Castings, Steel | Pound | 220,000 |
| 31 | Castings; Alloy Steel (Including Nickel) | Pound | 13,000 |
| 32 | Castings; Iron | Pound | 70,000 |
| 33 | Brass and Bronze | Pound | 11,000 |
| 34 | Miscellaneous Non-Ferrous Metals | Pound | |
| 35 | Pipe; Steel, Black, 12 inch Dia. | Lin.Ft. | |
| 36 | Pipe; Steel, Black 6 inch Dia. | Lin.Ft. | |
| 37 | Pipe; Steel, Black 4 inch Dia. | Lin.Ft. | |
| 38 | Conduit; Fiber, 3 inch Dia. | Lin.Ft. | |
| 39 | Conduit, Rigid Metal, 2 inch Dia. | Lin.Ft. | |
| 40 | Electrical Grounding System | Sum | Job |
| 41 | Handrailing; Steel Pipe | Lin.Ft. | |
| 42 | Rubber Seals; Moulded | Pound | |
| 43 | Corrugated Sheet; Iron | Pound | |
| 44 | Tile Gages | Lin.Ft. | |
| 45 | Core Boxes | Each | |
| 46 | Stiff-Leg Derrick Sand Machinery | Sum | Job |
| 47 | Pick-up Boom; 2 at 12,600 lbs. | Pound | |
| 48 | Machinery; Sector Gates, Furnished and Installed 8 sets | Pound | |
| 49 | Motors, Brakes and Limit Switches; for Sector Gates, Furnished and Installed | Set | 8 |
| 50 | Fender Boom | Pound | |
| 51 | Machinery; Wire Rope Fenders, Installed only, 4 sets | Pound | |
| 52 | Motors, Brakes and Limit Switches; for Wire Rope Fenders, Installed only | Set | 4 |
| 53 | Counterweight | C.W.T. (100lb.) | |
| 54 | Swing Bridge and Machinery; Complete | Sum | Job |
| 55 | Lock Unwatering Pumps and Sump Pumps | Sum | Job |
| 56 | Field Office | Sum | Job |
| 57 | Field Office Extension | Sum | Job |
| 58 | Seeding | Acre | |
| 59 | Rolling for Each Additional Two Trips | square (100sf) | |
| 60 | Gravel Fill Base | C.Y. | |
| 61 | Road Surfacing | Sq.Yd. | |
| 62 | Highway Guard Rail | Lin.Ft. | |
| 63 | Pipe; Corrugated Iron 24" dia. | Lin.Ft. | |
| 64 | Pressure Test; Grout Holes | Each | |

## 1-06. COMMENCEMENT, PROSECUTION AND COMPLETION.

(a) The contractor will be required to commence work under the contract within twenty (20) calender days after the date of receipt by him of notice to proceed, to prosecute the said work with faithfulness and energy, and to complete the entire work within ___________ calender days after said date of receipt by him of notice to proceed, plus any extensions of time duly granted under the provisions of the contract and specifications. The work shall be prosecuted as vigorously as practicable during all seasons of the year.

(b) In case of failure on the part of the contractor to complete the entire work within the time thus determined and agreed upon for its completion, the contractor shall pay to the Government as liquidated damages the sum of ______ for each calendar day of delay until construction is completed and the lock is placed in operating condition as determined by the contracting officer.

(c) Should the construction be completed and placed in operating condition except for minor finishing work as determined by the contracting officer, the contracting officer may conditionally accept and occupy the work; and thereafter the contractor shall pay to the Government, as liquidated damages the sum of _________ for each calender day of delay until all the items and minor finishing work have been completed and accepted.

(d) In the event the entire structure has been completed and accepted and all work under the contract has been completed except for removal of contractor's plant and buildings and restoration of the site, no further liquidated damages will be assessed, but final payment will not be made until this latter work has been accomplished as required.

(e) If the completion of the undertaking to be performed under the terms of this contract be delayed by reasons of delay in the delivery of materials or supplies essential to such performance because of national defense priorities and without the fault of negligence of the contractor, the time of performance will be extended for a period equal to such delay, as det mined by the contracting officer and subject to appeal as provided in Article 9 of the contract.

1-07. SUNDAYS, HOLIDAYS AND NIGHTS. - Work on Sundays, holidays, and nights will be at the option of the contractor. However, when the contractor elects to work at such times notice of his intention to do so shall be given contracting officer within a reasonable time in advance thereof.

## 1-08. PAYMENTS.

(a) (Availability of Funds?)

(b) Payments will be made monthly on estimates of work performed in accordance with the contract and not included in any prior estimate, excep that ten percent (10%) of the amount of each estimate will be retained until the total amount retained is _________ dollars(__________), and this amount wi be retained until it equals ten percent (10%) of the remaining work to be don Thereafter with each monthly payment there will be paid such portion of the a so retained as is in excess of ten percent (10%) of the work remaining to be until the amount retained is reduced _______ dollars (________), which amount w be retained until the completion of the contract when final payment will be m

## 1-09. WORK COVERED BY CONTRACT PRICE.

(a) The contractor shall, under his contract prices, furnish and pay for all materials (except as specified in paragraph 1-10), labor and equipment for all permanent, temporary, preparatory and incidental work, furnish all accessories and do everything which may be necessary to carry out the contract in good faith, which contemplates everything completed in good working order, of good material and with accurate workmanship, skillfully fitted and properly connected and put together.

### 1-10. MATERIALS FURNISHED BY THE UNITED STATES.

(a) The following material and equipment furnished by the United States will be delivered to the contractor f.o.b. Waddington, N. Y.

(1) Cement
(2) Reinforcing Steel
(3) Machinery for Wire Rope Fenders.

The contractor shall be responsible that all railroad cars are unloaded promptly and will be held liable for any demurrage charges due to his failure to do so. He will be required to unload, transport to site of work, store, and use these materials and equipment in accordance with the specifications, and contract drawings.

(b) All materials and equipment shall be adequately housed or otherwise protected against deterioration and damage. When material and equipment stored at the site is not adequately protected by the contractor, such material and equipment will be kept protected by the contracting officer at the expense of the contractor.

(c) Cement. - All cement furnished, except high early strength, will be a moderate-heat-of-hardening Portland cement conforming to Federal Specification SS-C-206 (a). Cement will be made available to the contractor at the aforementioned point of delivery at any time after the date of notice to proceed, but he shall give the Government at least 30 days notice in advance of the time he will require the first material, and thereafter he shall at all times keep the contracting officer informed of his anticipated requirements. Ten days before the first of each month or at such other times as may be directed by the contracting officer, the contractor shall furnish written notice of his future cement requirements for the next 30 days. The Government will at all times expedite the delivery of all orders but the Government will not be liable for any expense or delay caused the contractor by delayed deliveries, except as provided under Article 9 of the contract. Copies of all orders for cement will be furnished promptly to the contractor. The cement will be furnished in bulk except that necessary for grouting and finishing work, which will be furnished in paper bags. Any cement, bulk or bag, which is damaged after delivery to the contractor will be paid for by him. Any difference in excess of one-half of one percent between the net quantity of bulk cement delivered to the contractor, and the quantity incorporated in the completed and accepted work will be charged to the contractor, at its cost to the government at the point of delivery to the contractor. The quantity of bulk cement delivered to the contractor will be determined by certified shipping weights. The contractor shall provide, at the site, a storage for not less than 10,000 barrels of bulk cement and 500 barrels of bag cement. In order that cement will not become unduly aged after delivery, the contractor shall not use cement in the work directly from the freighting or transporting operations whenever any cement is available that has been stored more than 60 days after delivery to the contractor. Cement that has been stored for more than 90 days shall be retested at the expense of the contractor. (See paragraph 1-30(d). Storage bins for cement shall be constructed so that there will be no dead storage and so as to provide adequate protection against the elements.

(d) Cement furnished by the Government may be used by the contractor in erecting construction plants and facilities. The contractor will be billed for the actual cost to the Government at the point of delivery for furnishing the cement so used by the contractor. The materials thus used shall not be included in the one-half of one percent tolerance specified above.

(e) The contractor shall check the quantity and condition of all materials and equipment delivered to him at the time of unloading, and case there is damage to, or shortage of materials or equipment he shall report it to the contracting officer in writing within 24 hours after delivery. If there is any shortage, or damage which in the opinion of the contracting officer is sufficient to cause the materials or equipment to be unfit for use in the work, and the shortage or damage has not been reported as specified above, the contractor will be charged with the actual cost of replacement of such shortage or damage.

(f) The contractor shall return to the Government f.o.b. in cars at the aforementioned point of delivery, all cement furnished by the Government and not used. The contractor will be charged for any cement, not used and not returned, an amount equal to the cost to the Government at the point of delivery to the contractor.

(g) Reinforcement. - Steel reinforcement for concrete furnished by the Government at the aforementioned point of delivery will be mill bent, cut to required lengths and marked for identification. It will conform to Federal Specifications QQ-B-71a, type B, grades 2, 3, 4, or 5.

(h) Reinforcement will be made available to the contractor within 100 days after the contractor notifies the Government he will require such reinforcement, and he shall furnish written notice of his requirements for the first four months. Thereafter he shall at all times keep the contracting officer informed of his anticipated requirements for reinforcement in the following manner: On the first day of the first 4-month period the contractor shall furnish written notice of his future requirements during the second 4-month period, and so on through the duration of the contract. Upon receiving notice to proceed the contractor will also furnish the contracting officer a general schedule of reinforcement requirements for the duration of the contract by four-month periods, it being understood that shipments may be based on definite requirements as stated in the contractor's four monthly notices of requirements.

(i) The Government will at all times expedite the delivery of all orders but the Government will not be liable for any expense or delay caused by delayed deliveries, except as provided for under Article 9 of the contract. Copies of all orders for concrete reinforcement will be furnished promptly to the contractor.

(j) Any reinforcement which is damaged after delivery to the contractor, and any difference in excess of one-half of one percent between the net quantity of reinforcement delivered to the contractor and the quantity incorporated in the completed and accepted work will be charged to the contractor, at its cost to the Government at the point of delivery to the contractor. The quantity of reinforcement delivered to the contractor will be determined by certified shipping weights.

(k) Wire Rope Fender Machinery. - Four complete sets of wire rope fender machinery, as shown on the drawings and described in Sections VIII and XIII, furnished by the Government at the aforementioned point of delivery, will include wire rope, fixed metal, motors, brakes and limit switches, and all other parts necessary for the four complete fenders except the fender booms. The contractor shall notify the contracting officer at least 60 days in advance of the time he desires delivery of machinery units.

1-11. ELECTRICAL ENERGY DURING THE CONTRUCTION PERIOD.

(a) The contractor shall make arrangements and provide without cost to the United States, all facilities and equipment necessary to furnish himself with electrical energy for power and lighting. This shall include bringing power from existing lines in the vicinity to the site, and the provision of transformers, poles, wire, switches, lights and other equipment that may be necessary. The contractor will be required to light, without cost to the Government during the construction period all job roads, work areas, all safety lights, range lights and other lighting as directed by the contracting officer. Energy shall be 3-phase, 60-cycle for the operation of all permanent equipment installed in the lock and shall be furnished at the voltage required for each specific use indicated on the drawings. The contractor shall maintain service until completion of the contract. All costs for furnishing electrical energy, including furnishing, installation, maintenance and removal of all temporary equipment, shall be borne by the contractor.

(b) The contractor shall provide for the period of this contract the electrical energy for lighting and miscellaneous use in the government field office (Section XVIII). The contractor shall provide an electric meter in the field office, and will be paid each month by the Government for the electrical energy furnished the field office at the rate of the actual cost to the contractor of such electrical energy. The energy required in the field office shall be 220/110-volt, 60-cycle, single-phase, 3 wires.

1-12. ORDER OF WORK. - Work shall be carried on at such places and also in such order of precedence as may be found necessary by the contracting officer, and shall be constructed in every part in exact conformity with the location and limit marks, which will be indicated by stakes, lines, marks or otherwise.

1-13. RIGHT-OF-WAY. - The right-of-way for the work covered by these specifications will be furnished by the Government.

1-14. ROAD AND GROUNDS.

(a) The contractor shall have the privilege of using the Government-controlled land at the site, except for that part of said lands as may be reserved by the contracting officer for other purposes.

(b) Prior to commencement of work under the contract, the contractor shall submit, for the approval of the contracting officer, prints in triplicate showing the location of the major plant, buildings, roadways, unloading facilities and storage yards which he proposes to construct on the Government-controlled lands at the site.

(c) At any time during the progress of the work the contractor shall, when so directed by the contracting officer, promptly vacate and clean up, within 60 days after written notice, without expense to the Government, any part of the grounds which have been in use by him when such grounds are needed for other purposes. The contractor shall keep the buildings and grounds in use by him at the site of the work in an orderly and sanitary condition and shall provide suitable extinguishers or other fire-fighting apparatus for ready use in all buildings erected or in use by the contractor on Government property.

(d) The contractor shall not obstruct any existing roads on the lands controlled by the United States and shall maintain all roads in the vicinity of the work in as good condition as exists at the time of commencement of the work.

(e) The contractor will be required to construct a covered wooden observation platform having an area of about six-hundred (600) square feet for the use of the general public. This platform will be constructed at a location selected by the contracting officer. The contractor will also provide suitable and safe access to the observation platform for the general public so that it may observe the work in progress. No separate payment will be allowed for this work.

## 1-15. CAMP CONSTRUCTION AND SUPERVISION.

(a) The construction, operation and maintenance of facilities for the quartering and subsisting of the contractor's employees will be subject to the approval of the contracting officer if the facilities are located on Government property. The contractor will be permitted to construct such facilities on the right-of-way owned by the Government only at such locations specifically approved by the contracting officer. The type of construction and design for the buildings erected by the contractor will be subject to the approval of the contracting officer. Expensive or permanent types of construction will not be required, but no unsightly, unsanitary shacks or shanties will be permitted. The contractor will be required to comply with State and local laws relative to police and sanitary measures and with other protective measures imposed by the contracting officer in the administration of his camps. In the event of noncompliance with such laws and regulations, the contracting officer will enforce them at the expense of the contractor. The contracting officer may require the contractor to discharge any employee from the work for violation of camp regulations.

(b) In the event the contractor makes arrangements with landowners, other than the Government, near the site of the work for the construction of temporary facilities for the quartering and subsisting of his employees, he will be subject, in the operation and maintenance of such a camp to all the provisions of subparagraph (a) above with respect to the requirements for compliance with all State and local laws relative to police and sanitary measures, and with measures such as safety, fire hazard and protection, etc., imposed by the contracting officer. In the event of noncompliance with such laws and regulations while operating and maintaining a temporary camp not on the Government-owned or controlled property, the contracting officer may require the contractor to discharge from the work any employee for violation of camp regulations, notwithstanding the fact that the camp may not be located on Government-owned or controlled property.

(c) In the event the contractor provides subsistence for his employees, he shall also provide subsistence to such Government employees as may require such accommodations and at the same rates charged his own employees.

(d) No business or recreational facilities shall be established or operated on Government-owned or controlled lands without the written approval of the contracting officer.

1-16. DATUM AND REFERENCE BENCH MARKS. - The plane of reference used in these specifications and on the drawings is Mean Sea Level. Elevations referring to this datum plane are to be determined from the following bench mark: See Bulletin 514, Results of Spirit Leveling in New York. U. S. Geological Survey, page 60.

> Tilden, on north side of river road, on town line between Lisbon and Waddington, on southeast face of postoffice, 7.2 feet from south corner, 0.8 feet above ground; center punch mark in a brass bolt cemented into foundation stone marked "U.S." (U. S. Corps of Engineers 13). Elevation 269.953.

1-17. PHYSICAL DATA.

(a) Foundation data. - Investigations, borings, probings, test trenches, pits and test shafts made at the site by the United States to determine the character of the foundation materials are shown on sheets Nos. 5 to 10 inclusive, of the drawings referred to in paragraph 1-04.

The United States does not guarantee that other materials will not be encountered nor that the proportions of the several materials will not vary from those indicated by the explorations. Bidders are expected to examine the site of the work, the logs of borings, test pits, probings, and the cores and samples which are available at the U. S. Engineer Office, Massena, New York, and after investigation decide for themselves the character of the materials and make their bids accordingly.

(b) Weather Conditions. - Meteorological data in the form of rainfall and temperature records, prepared from records covering a period of 33 years (1907 to 1939, inclusive) of the U. S. Weather Bureau Station at Canton, New York, approximately 35 miles southwest of the site of the work, are as follows:

| | Temperature Degrees Fahrenheit | | | Precipitation (Mean Monthly) | |
|---|---|---|---|---|---|
| Month | Mean Monthly | Extreme Max. | Extreme Min. | Total Inches | Inches of Snow |
| January | 16.8 | 61 | -41 | 2.64 | 14.9 |
| February | 15.8 | 63 | -43 | 2.30 | 15.5 |
| March | 27.9 | 78 | -30 | 2.60 | 13.1 |
| April | 41.7 | 85 | -1 | 2.59 | 4.9 |
| May | 54.2 | 93 | 21 | 3.03 | 0.2 |
| June | 63.5 | 97 | 30 | 3.51 | 0 |
| July | 68.8 | 99 | 34 | 3.62 | 0 |
| August | 66.5 | 96 | 35 | 3.42 | 0 |
| September | 58.8 | 91 | 25 | 3.44 | 0.1 |

| Month | Temperature Degrees Fahrenheit<br>Mean Monthly | Extreme Max. | Extreme Min. | Precipitation (Mean Monthly)<br>Total Inches | Inches of Snow |
|---|---|---|---|---|---|
| October | 47.4 | 83 | 14 | 3.04 | 1.0 |
| November | 35.0 | 75 | -15 | 3.02 | 7.5 |
| December | 21.4 | 61 | -37 | 2.62 | 14.5 |

(c) St. Lawrence River Water Temperature. - The St. Lawrence River water temperatures prepared from records covering a period of 8 years (1933 to 1940, inclusive) of the City Engineer, Ogdensburg, New York are as follows:

| Month | Water Temperature Degrees Fahrenheit<br>Mean Monthly | Extreme Max. | Extreme Min. |
|---|---|---|---|
| January | 32.7 | 36 | 32 |
| February | 32.9 | 37 | 32 |
| March | 33.0 | 37 | 32 |
| April | 36.2 | 46 | 32 |
| May | 46.9 | 60 | 37 |
| June | 58.8 | 66 | 49 |
| July | 65.5 | 73 | 59 |
| August | 70.5 | 74 | 63 |
| September | 64.6 | 72 | 59 |
| October | 56.4 | 65 | 50 |
| November | 46.5 | 52 | 37 |
| December | 35.7 | 44 | 32 |

The above data are included for the information of the contractor. The Government assumes no responsibility for their completeness or accuracy or for deductions, interpretations, or conclusions drawn therefrom.

(d) River Stages. - The mean flow of the St. Lawrence River during the period 1860 to 1940 was 37,000 c.f.s. The maximum monthly mean discharge during the period was 314,000 c.f.s. and the minimum 144,000 c.f.s. The stage elevations near the entrance to the proposed lock, corresponding to the above discharges, are El. 225.8, mean; El. 230.4 maximum; and El. 219.4 minimum. The standard low water datum is El. 223.3 for a discharge of 197.000 c.f.s.

(I) In the event that power lines, telephone or telegraph lines, pipe lines, cables, or other utilities are encountered within the limits of the work including the access right-of-way, the contractor shall notify the contracting officer in writing of any necessary changes in such utilities not less than 30 days in advance of the date he desires such changes made. The contracting officer will arrange for the relocation or reconstruction of such utilities by other agencies, or will authorize the contractor to remove them, at no extra cost to the Government, to the extent required for execution of the contract work.

1-18. TRANSPORTATION FACILITIES. - The following data on transportation facilities is furnished for the information of the contractor but the Government assumes no responsibility for its completeness or accuracy and the contractor is expected to investigate the conditions and determine for himself the probable transportation facilities available.

(a) Railroads. - The Norwood and St. Lawrence Railroad serves the village of Waddington, N. Y. approximately 3 miles east of the lock site. The Rutland Railroad passes approximately eight miles south of the lock site.

(b) Highways. - New York State Highway No. 37 between Waddington and Ogdensburg passes approximately 2 miles southeast of the lock site.

(c) Water. - The site of the work is accessible by water from Lake Ontario and from the head of deep-water navigation at Montreal by means of the St. Lawrence Canals and open-river stretches of navigable channels. Locks in the canals generally limit the size of craft to widths less than 45 feet, lengths less than 250 feet, and drafts less than 14 feet. For a detailed description of the existing canal and lock clearances and depths, the contractor is referred to the booklet "The Canals of Canada," published by the Department of Transport, Ottawa, Ontario, Canada, copies of which are available for inspection in the U. S. Engineer Office, Massena, N. Y. The navigation season is usually limited by ice conditions to the period from April 20 to December 1.

### 1-19. ORGANIZATION, PLANT AND PROGRESS.

(a) The contractor shall perform, directly and without subcontracting, not less than fifty percent (50%) of the work, to be calculated on the basis of the contract price.

(b) The contractor shall employ an ample force of properly experienced men and provide a construction plant properly adapted to the work and of sufficient capacity and efficiency to accomplish the work in a safe and workmanlike manner at the rate of progress specified in his bid. All plant shall be maintained in good working order and provision shall be made for immediate emergency repairs. No reduction in the capacity of the plant employed on the work shall be made except by written permission of the contracting officer. The measure of the "capacity of the plant" shall be its actual performance on the work to which these specifications apply. It is understood that award of this contract shall not be construed as a guaranty by the United States that plant listed in statement of contractor for use on this contract is adequate for the performance of the work.

(c) Should the contractor fail to maintain the rate of progress proposed in his bid, the contracting officer may require that additional men or plant, or both, be placed on the work, working if necessary during additional periods, or a reorganization of plant layout be effected in order that work be brought up to schedule and maintained there. Should the contractor refuse or neglect so to increase the number of men or plant, or both, or to reorganize the plant layout in the manner satisfactory to the contracting officer, the latter may proceed under the provisions of Article 9 of the contract.

### 1-20. LIABILITY AND SAFETY REQUIREMENTS.

(a) Accident Prevention. - In order to protect the life and health of employees in the performance of this contract, the contractor will comply with all pertinent provisions of the "Safety Requirements in Excavation - Building - Construction" approved by the Chief of Engineers, December 16, 1941, (a copy of which is on file in the office of the contracting officer) and as may be amended, and will take or cause to be taken such additional measures as the contracting officer may determine to be reasonably necessary for this purpose. The contractor will maintain an accurate record of an will report to the contracting officer in the manner and on the forms prescribed by the contracting officer, all cases of death, occupational disease and traumatic injury arising out of or in the course of employment on work under this contract. The contracting officer will notify the contractor of any non-complience with the foregoing provisions and the action to be taken. The contractor shall, after receipt of such notice, immediately correct the conditions to which attention has been directed. Such notice, when served on the contractor or his representative at the site of the work, shall be deemed sufficient for the purpose aforesaid. If the contractor fails or refuses to comply promptly, the contracting officer may issue an order stopping all or any part of the work. When satisfactory corrective action is taken, a start order will be issued. No part of the time lost due to any such stop order shall be made the subject of claim for extension of time or for excess costs or damages by the contractor.

(b) The contractor will not be allowed to block or obstruct any public highway without having secured prior permission from the contracting officer, and he shall provide safe, temporary detours. During the time the public highways may be so blocked, the contractor shall place danger lights, barricades and warning signs in accordance with the laws of the State of New York.

(c) The contractor shall be responsible that his employees strictly observe the laws of the United States affecting all operations at the site under the contract. He shall comply with all applicable Federal, State and local laws, including those concerning the inspection of boilers and other equipment, the licensing of engineers and other employees.

(d) The United States will not be responsible for any damage to or increased difficulties in performance of the work under this contract on account of any scour or other changes in the river bed or banks or water currents resulting from other construction at the site, and no payments, allowances or deductions will be made for or on account of any such damage or difficulties.

(e) Nothing in this paragraph shall be construed as modifying the responsibility of the contractor as set forth in Article 10 of the contract.

1-21. LIGHTS. - The contractor shall, at his own expense, display proper lights continuously each night, between the hours of sunset and sunrise and during fogs, on all floating plant connected with the work, and shall be responsible for all damages resulting from any neglect or failure in this respect. If work is done at night the contractor shall maintain, from sunset to sunrise, such light on or about his plant as the contracting officer may deem necessary for the proper observation of the operations.

1-22. USE OF EXPLOSIVES. - The contractor shall use the utmost care in the use of explosives necessary for the prosecution of the work, not to endanger life or property. All blasting operation shall be conducted by experienced men only. The handling and use of explosives shall be done strictly in accordance with the latest methods and rulings to insure safety, in accordance with the specifications issued by the U. S. Bureau of Mines, and in compliance with the local and State laws. Failure to observe necessary precautions will be sufficient grounds for temporary suspension of the work. All explosives shall be transported and stored in a secure manner, and in accordance with local and State laws; all vehicles and such storage places shall be marked clearly "**DANGER - EXPLOSIVES**," and shall be in the care or competent watchmen at all times. In no case shall caps or other detonators be stored or transported with dynamite or other explosives. The location of magazines for the storage of explosives and for the separate storage of detonators shall be subject to the approval of the contracting officer.

## 1-23. PROPERTY DAMAGE.

(a) Damage to Government property or to the works due to failure of the contractor to carry out the terms of the contract and specifications, to take reasonable precautions, or to maintain progress to approved schedules, or to carry out the instructions of the contracting officer shall be made good by the contractor without expense to the United States. He will also be held responsible for any damage done to adjoining property through his neglect or failure to take proper precautions (See Article 10 of the contract).

(b) The contractor will not be held responsible for damage sustained by the permanent work from accidnet, flood, or exposure where such damage is not due to his fault or negligence and where the work is being conducted in accordance with the terms and schedule of the contract and specifications, but he shall make such repairs as the contracting officer may direct to such damaged portions of the work, at the applicable contract unit prices for the various items of work.

## 1-24. INSPECTION.

(a) The work will be conducted under the general direction of the contracting officer and will be inspected in accordance with Article 6 of the contract by inspectors appointed by him. The inspectors will keep a record of the work done and see that the location and limit marks are kept in proper order, but the presence of the inspector shall not relieve the contractor or his responsible agent (See Article 8 of the contract) of responsibility for the proper execution of the work.

(b) Should the contractor refuse, neglect or delay compliance with the requirements concerning facilities for inspection and layout (See paragraph 1-25), the specific facilities may be furnished and maintained by the contracting officer, and the cost thereof deducted from any amounts due or to become due the contractor.

(c) Except as specified in this paragraph, in Article 6 of the contract, and in paragraphs 1-30(d) and 1-25, all expenses of inspection will be borne by the United States.

(d) The contractor shall furnish a suitable room containing at least 150 square feet of floor space, at his concrete mixing plant for a Government laboratory to be used for temporary storage of concrete cylinders, and determination of moisture content of the concrete aggregate. This room shall be protected from the weather, properly lighted, provided with necessary work tables and benches, and shall be suitably heated. The location for this room shall be subject to the approval of the contracting officer. The contractor shall provide, during the construction period, electricity for light and miscellaneous uses, see paragraph 1-11(b), and an adequate supply of water for drinking and sanitary purposes in the Government field office, constructed in accordance with Section XVIII of these specifications.

(e) Portable Building. - The contractor shall furnish a suitable portable building, located as required by the contracting officer within the site of the work, for use by the Government. This building shall be approximately 10 feet by 12 feet and shall be supplied with an instrument rack, a built-in desk, clothes lockers, supply cabinet with lock, bench and such other appurtenances as may be required by the contracting officer. The building may be of any type construction as approved by the contracting officer and shall be movable, as the contracting officer may require its location to be shifted during progress of the work. It shall be reasonably weather proof, and shall be supplied with heat and electric lights without cost to the Government.

(f) It is understood that any instructions, or decisions given by a superior officer, through the contracting officer, are to be considered instructions or decisions of the contracting officer, in all cases where, under the terms of this contract, decision rests with the contracting officer.

### 1-25. LINES, GRADES AND MEASUREMENTS.

(a) The work shall be carried out in strict accordance with lines, grades, and dimensions shown on the drawings or as directed from time to time by the contracting officer.

(b) The contractor shall, at his own expense, furnish all stakes, templates, patterns, platforms and special labor that may be required in setting and cutting, or laying out any part of the work.

(c) The contracting officer will furnish the control points, lines, grades, and elevations necessary to enable the contractor to perform the construction work. After this layout has been made by the contracting officer, it shall be the responsibility of the contractor to supply and maintain all additional survey points, grade stakes, form locations and other work lines necessary for the proper execution and conduct of the work. From time to time during the progress of the work, the contracting officer will check the contractor's lines and grades to determine whether or not the work is being accurately and properly executed, but such checks will in no way relieve the contractor of the responsibility for executing the work in accordance with the plans and specifications, and the field layout furnished by the contracting officer.

(d) Bench marks, triangulation stations, and principal control points shall be preserved by the contractor and in case of their destruction or removal by him or his employees, they will be replaced by the contracting officer at the contractor's expense.

1-26. CHANGES AND CHANGED CONDITIONS. - When changes are made in the specifications or drawings, or changed conditions are encountered during the progress of the work, which cause an increase or decrease in the amount due under the contract, or in the time required for its performance, an equitable adjustment shall be made in accordance with

Article 3 and 4 of the contract.

1-27. MINOR MODIFICATIONS. - The right is reserved to make such minor changes in the execution of the work to be done under these specifications as, in the judgment of the contracting officer, may be necessary or expedient to carry out the intent of the contract; provided, that the unit cost to the contractor of doing the work shall not be increased thereby, and no increase in unit price over the contract rate will be paid to the contractor on account of such changes. (See Articles 3, 4, and 5 of the contract).

1-28. CLAIMS, PROTESTS AND APPEALS.

(a) If the contractor considers any work demanded of him to be outside the requirements of the contract or if he considers any action or ruling of the contracting officer or of the inspectors to be unfair, the contractor shall without undue delay, upon such demand, action, or ruling, submit his protest thereto in writing to the contracting officer, stating clearly and in detail the basis of his objections. The contracting officer shall thereupon promptly investigate the complaint and furnish the contractor his decision, in writing, thereon. If the contractor is not satisfied with the decision of the contracting officer, he may, within thirty days, appeal in writing to the Chief of Engineers, whose decision shall be final and binding upon the parties to the contract. Except for such protests or objections as are made of record in the manner herein specified and within the time limit stated, the records, rulings, instructions or decisions of the contracting officer shall be final and conclusive.

(b) The Chief of Engineers has been designated by the Secretary of War as his only authorized representative to make final decision and to take other action where the terms of the contract require that such decision or action shall be "by the Head of the Department concerned or his duly authorized representative." All appeals from decisions of the contracting officer authorized under the contract shall, therefore, be addressed to the Chief of Engineers, U. S. Army, Washington, D. C. The appeal shall contain all the facts or circumstances upon which the contractor bases his claim for relief and should be presented to the contracting officer for transmittal within the time provided therefore in the contract.

1-29. PATENTS. - The contractor shall hold and save the Government, its officers, agents, servants and employees, harmless from liability of any nature or kind, including costs and expenses for or on account of any patented or unpatented invention, article or appliance manufactured or used in the performance of this contract, including its use by the Government.

1-30. STANDARD TESTS, QUALITY AND GUARANTEES.

(a) All materials furnished by the contractor, supplies and parts, and assemblies therof, entering into the work to be done under these specifications, shall be tested as specified herein, or if not specified, in conformity with Article 6 of the contract and according to the best modern approved methods for the particular type and class of work.

(b) Unless otherwise authorized or directed, where standard published specifications of recognized authorities or organizations are specified, the latest revision of such specifications current at the time the work is executed shall govern.

(c) Unless waived in writing by the contracting officer, all tests and trials shall be made in the presence of a duly authorized representative of the contracting officer. When the presence of the inspector is so waived, sworn statements, in triplicate, of the tests made and the results thereof, shall be furnished the contracting officer by the contractor as soon as possible after the tests are made.

(d) All costs of all tests and trials, excepting the expenses of the Government inspector, shall be borne by the contractor and shall be included in the contract price, unless specified otherwise.

(e) In accordance with Article 7 of the contract, all materials, supplies and articles furnished and incorporated in the permanent structure shall be of the highest grade, free from defects and imperfections, of recent manufacture, and unused. Workmanship shall be of the highest grade and in accordance with the best modern standard practice.

(f) All articles, supplies, equipment, parts and assemblies thereof, of standard manufacture, or for which detail design or requirements are not prescribed in these specifications shall be guaranteed by the contractor against any failure in proper use or operation, caused by defective material, workmanship or design, for a period of one year from the date of final acceptance of the complete work under this contract. Failure in any part due to such causes within that time shall be promptly and satisfactorily remedied by the contractor without cost to the United States.

1-31. PROTECTION OF STORED MATERIALS. - All materials, supplies and articles delivered at the site shall be adequately housed or otherwise protected against deterioration and damage to the satisfaction of the contracting officer. When material stored at the site and partly paid for is not adequately protected by the contractor, such material will be kept protected by the contracting officer at the expense of the contractor, and no partial payments will be made upon future delivery of the articles or commodities in question.

1-32. MISPLACED MATERIAL. - Any material that is deposited elsewhere than place designated or approved by the contracting officer will not be paid for, and the contractor may be required to remove such material and waste it or redeposit it as directed.

### 1-33. STANDARD STOCK PRODUCTS.

(a) All materials, supplies and articles furnished shall, wherever so specified, and otherwise wherever practicable, be the standard stock products of recognized reputable manufacturers. The standard stock products of manufacturers other than those specified will be accepted when it is proved to the satisfaction of the contracting officer that they are equalin strength, durability, usefulness and convenience for the purpose intended (See Article 7 of the contract). Any changes required in the details and dimensions shown on the drawings for the substitution of standard stock products, other than those provided for, shall be properly made as approved by the contracting officer, and at the expense of the contractor. The references herein to brands and catalog numbers are intended to be descriptive and not restrictive, and are used only to indicate articles that will be satisfactory. Other makes and catalog numbers will be accepted, provided that they are similar and equal to those specified herein or called for on the drawings.

(b) Data to be Submitted for Approval. In accordance with Article 7 of the contract, prior to the placing of any purchase order for products of standard manufacture, and sufficiently in advance of the proposed purchase date to enable the contracting officer to determine whether the proposed product conforms to the specifications, the contractor shall submit for the approval of the contracting officer complete descriptive data in triplicate, consisting of dimensioned drawings, catalog references and specifications, typical performance records, and such other information as may be required to be submitted on special forms to be furnished by the contracting officer to identify clearly each product in question. The term "or equal" shall not be used in any descriptive information furnished. Except at the contractor's risk, no purchase order shall be placed for any product which has not been approved by the contracting officer.

(c) Final Completion Data. - There shall be supplied 5 complete sets of data, each separately bound in a leather binder, for each major item of equipment furnished and installed under this contract. These data shall consist of all necessary instruction bulletins, complete drawings, complete parts and material lists positively identifying each part, manufacturer's recommendation as to spare parts, and all other necessary data.

## 1-34. PREFERENCE FOR DOMESTIC ARTICLES.

(a) With reference to article 18 of the contract, because the materials listed below, or the materials from which they are manufactured, are not mined, produced, or manufactured, as the case may be, in the United States in sufficient and reasonably available commercial quantities and of a satisfactory quality, their use in the work herein specified is authorized without regard to the country of origin:

Platinum
Chromium
Cork
Jute
Kaurigum
Lac
Nickel
Asphalt
Rubber
Teak Wood
Silk
Sisal
Tin
Asbestos
China Wood Oil (Tung Oil)
Balsa Wood
English Ball Clay
English China Clay
Natural Copper-Nickel Alloy
Diamonds

(b) Articles, materials or supplies manufactured in the United States and containing mercury, antimony, tungsten or mica of foreign origin may be used in the work herein specified because such manufactured articles, materials, or supplies have been manufactured in the United States substantially all from articles, materials, or supplies, mined, produced or manufactured, as the case may be, in the United States.

1-35. INTERFERENCE WITH OTHER CONTRACTORS. - Other contractors will perform work at and in the vicinity of Point Rockway Lock.

The contractor shall not interfere with material, appliances or workmen of the United States or of any other contractor who may have work at this site. As far as practicable, all contractors shall have equal rights to the use of all roads, grounds and adjacent river, and make equitable agreements among themselves for the use of temporary railroads and highways. In case of disagreement regarding such use, the decision of the contracting officer shall govern. (See Article 13 of the contract).

1-36. RESTORATION OF SITE. - Before final payment is made, the contractor shall remove from the site, without expense to the United States, all rubbish, unused materials provided by him, temporary buildings, cofferdams and other structures erected by him, shall fill all holes or cavities made for his convenience, except as otherwise provided and shall leave the whole site in good order and condition, all as required by the contracting officer.

1-37. WAGE AND LABOR PROVISIONS.

(a) Pursuant to the provisions of Article 17 of revised United States Standard Form No. 23 the following wage rates have been determined by the Department of Labor:

### SCHEDULE OF WAGE RATES

| Classification | Minimum Rate per Hour |
|---|---|
| Blacksmith | |
| Blacksmith Helper | |
| Boilermaker | |
| Boilermaker Helper | |
| Bricklayer | |
| Bricklayer Helper | |
| Carpenter (Skilled) | |
| Carpenter, Apprentice, 1st year | |
| Carpenter, Apprentice, 2d year | |
| Carpenter, Apprentice, 3d year | |
| Concrete Finisher (Rough concrete) | |
| Concrete Form Stripper | |
| Concreteman (Puddler, Screeder, Vibratorman & Curing) | |
| Conveyor Tender | |
| Dumpman (Spotter & Grademan) | |
| Electrician | |
| Electrician Helper | |
| Engineman (Stationary Power Plants) | |
| Fireman | |
| Glazier | |
| Hooktender (Concrete Placement) | |
| Laborer (Common) | |
| Machinist | |
| Machinist Helper | |
| Mason (Stone) | |
| Mechanic | |
| Mechanic Helper | |
| Millwright | |
| Motorman (Dinky) | |
| Oiler | |

| Classification (Cont'd) | Minimum Rate per Hour |
|---|---|
| Operators of Power Equipment: | |
| Air Compressor (over 750 c.f.m.) | |
| Air Compressor (750 c.f.m. and under) | |
| Air Hammer (Jackhammer, Pavement Breaker, etc.) | |
| Cement Pump | |
| Concrete Batching Plant | |
| Concrete Mixer | |
| Concrete Pump | |
| Core Drill | |
| Crane (except Gantry Crane) | |
| Derrick | |
| Dragline | |
| Elevating Grader | |
| Gantry Crane | |
| Grader (Finish) | |
| Grader (Rough) | |
| Grout Machine | |
| Hoist | |
| Launch Operator (150 H.P. or under) | |
| Pile Drive | |
| Power Saw | |
| Power Scraper | |
| Pump (100 H.P. or over) | |
| Pump (under 100 H.P.) | |
| Screening Plant | |
| Shovel | |
| Tractor (under 35 H.P. without attachments) | |
| Tractor (35 H.P. and over, and all tractors with attachments) | |
| Painter | |
| Pile Drivermen, Leadsmen, Linesmen, Nozzlemen, Winchmen | |
| Pipe Fitter | |
| Pipe Fitter Helper | |
| Plasterer | |
| Plasterer Tender | |
| Plumber | |
| Plumber Helper | |
| Powderman | |
| Powderman Helper | |
| Reinforcing Steel Worker | |
| Rigger | |
| Roofer | |
| Sheetmetal Worker | |
| Signalman, Concrete Placement (Phone man) | |
| Structural Steel Worker | |
| Structural Steel Worker Helper | |
| Teamster (2 up) | |
| Teamster (4 up or more) | |
| Tool Dresser | |
| Truck Driver (under 4 tons) | |
| Truck Driver (4 tons to 10 tons) | |
| Truck Driver (over 10 tons) | |
| Welder (Certified - structural steel) | |
| Welder (Certified - other than structural steel) | |
| Welder's Helper | |

(b) Each class of laborer and mechanic specified in the above schedule shall receive not less than the minimum rate of wages specified therein, except that deductions from wages paid may be made as required by any laws now or hereinafter in force, in the state in which this project is situated, calling for contributions by employees from earnings to funds maintained in the administration of an unemployment compensation law under the Social Security Act. In the event that it becomes necessary to employ any laborer or mechanic whose work is not covered by any of the classifications in said schedule, he shall be paid not less than the prefailing rate of wages for the class of work done by him. Such rate shall be predetermined by the contracting officer. In case any dispute arises as to what are the prevailing rates of wages for work of a similar nature which cannot be adjusted by the contracting officer, the matter shall be referred to the Secretary of Labor for determination and his decision theron shall be conclusive on all parties hereto.

(c) The contractor will be required to furnish identification badges for all his employees. These badges will show the employee's photograph, printed name, and signature, and will be of a design approved by the contracting officer.

(d) The contractor, in performing the work required by this contract, shall no discriminate against any worker because of race, color, creed, or national origin.

(e) The contractor agrees that the provision of paragraph (d) above will also be inserted in all of his subcontracts. For the purpose of this article a subcontract is defined as any contract entered into by the contractor with any individual, partnership, association, corporation, estate, or trust, or other business enterprise or legal entity, which involves performance, wholly or in part at the site of the work, of some part of the work to be performed under this contract.

1-38. REPORTS TO DEPARTMENT OF LABOR. - The contractor will report monthly, and will cause all subcontractors to report in like manner, within five days after the close of each calendar month, on forms to be furnished by the Department of Labor, the number persons on their respective payrolls, the aggregate amount of such payrolls, the man hours worked, and the total expenditures for materials. He shall furnish to the Department of Labor the names and addresses of all subcontractors on the work at the earliest date practicable, provided that the foregoing shall be applicable only to work at the site of the construction project. Copies of all data furnished the Department of Labor shall be promptly furnished the contracting officer.

1-39. INVOICES. - The contractor shall furnish the contracting officer with copies of all invoices for the purchase of materials, supplies and plant in connection with the work to be performed under these specifications. The contractor's records shall be subject to inspection by the contracting officer to verify the accuracy and completeness of the information furnished.

1-40. COST DATA. - The Government will keep a record of the costs of the work performed under these specifications and the contractor shall permit the contracting officer to have access to his timekeeping, invoices and plant records for this purpose. The contractor shall also furnish the contracting officer with a statement of the initial cost and date of purchase of all plant used in connection with the work.

1-41. ADJUSTMENT OF CONTRACT PRICE BY REASON OF CHANGE IN FEDERAL, STATE OR LOCAL TAXES. - The contract price will be considered to include all Federal, State and local taxes imposed prior to the date of opening bids and applicable to the undertaking. If any privilege, sales, gross receipts or other tax (exclusive of taxes on net income or distributed profits), applicable to the undertaking and payable directly by the contractor, is imposed or changed after the date of opening bids by Federal or State enactment, then the contract price will be increased or decreased accordingly and any amount due or chargeable against the contractor as a result thereof will be adjusted on payment vouchers as separate items.

1-42. SUBCONTRACTORS. - Subcontractors and their employees shall be considered to be employees of the contractor as the term "employee" is used in these specifications.

1-43. SITE OF WORK. - The term "Site of the Work", as used in these specifications and in Articles 17 and 19 of the contract, will embrace all areas wherein field operations are conducted by the contractor in connection with this contract, including work areas, shops, yards, camps, etc., irrespective of whether such operating areas lie within the limits of work areas or rights-of-way shown on the drawings.

1-44. ASSIGNMENT OF CLAIMS. - The Act of October 9, 1940 (Public No. 811, 76th Congress) provides that Sections 3477 and 3737, Revised Statutes, shall not apply to any case in which the moneys due or to become due from the United States, under a contract providing for payments aggregating $1,000 or more, are assigned to a bank, trust company, or other financing institution, including any Federal lending agency. An assignment may be made under this contract, pursuant to the Act of October 9, 1940, cited above, and subject to the further provision stated below:

(a) Any assignment shall cover all amounts payable under this contract and not already paid and shall not be made to more than one party, except that any such assignment may be made to one party as agent or trustee for two or more parties participating in such financing.

(b) Any claim under this contract which may be assigned may be subject to further assignment to a bank, trust company, or other financing institution, including any Federal lending agency, and to similar further assignment; provided, that any such assignee shall file written notice of the further assignment together with a true copy of the instrument of further assignment with the contractor and also as provided in proviso 4 of section 1 of the Assignment of Claims Act of 1940 (Public No. 811, 76th Congress) in respect of original assignment.

(c) No assignee shall divulge any information concerning the contract, or contained therein, except to those persons necessarily concerned with the transaction.

(d) Payments to an assignee of any claim arising under this contract shall not be subject to reduction or set off for any indebtedness of the assignor to the United States arising independently of this contract.

### 1-45. ADJUSTMENT OF PRICES FOR LABOR AND MATERIALS. -

(a) The following terms used hereafter are defined as follows:

(1) "Basic hourly earnings index" shall be determined by adding monthly average hourly earnings in the "____________" industry as indicated under headin "______________________________" in the monthly pamphlet "Hourly Wages and Labor Employment" issued by the Department of Labor for: the month in which contract time commences, the five (5) months preceding such month, and the six (6) months succeeding such month; and then dividing this total by twelve (12).

(2) "Basic materials index" shall be determined by method in (1) above, using monthly indices for item "______________________" in the monthly pamphlet "Wholesale Prices" issued by the Department of Labor

(3) "Monthly labor adjustment index" shall be determined from monthly average hourly earnings identified as to source in (1) above as follows: Add the average hourly earnings for the month for which adjustment is being made, the two preceding months and the two succeeding months; and then divide this total by five (5).

(4) "Monthly materials adjustment index" shall be determined by method in (3) above, using monthly indices identified as to source in (2) above.

(5) Above contract indices in (1), (2), (3), and (4) shall be computed to nearest second decimal place, taking the decimal point as located in indices issued by the Department of Labor. When third decimal place computes to 5 or over, the figure in second decimal place shall be raised to next higher figure.

(b) (1) The proportion of the contract price represented by labor, subject to adjustment in price, is accepted as ______________________ per cent of the contract price.

(2) The proportion of the contract price represented by materials, subject to adjustment in price, is accepted as __________________ per cent of the contract price.

(c) (1) The labor cost for entire contract as determined in (b) (1) above shall within thirty (30) days after receipt of notice to proceed, be divided into monthly labor cost quotas, prepared by the contractor and subject to the approval of the contracting officer, for each partial or whole calendar month of the contract time beginning with the notice to proceed.

(2) The materials cost for entire contract as determined in (b) )2) above shall be similarly divided into monthly materials cost quotas within thirty (30) days after receipt of notice to proceed.

(d) Adjustments in payments shall be obtained for each monthly cost quota as follows: Multiply monthly cost quota by the appropriate monthly adjustment index, divide by corresponding basic index, and subtract monthly cost quota. The result shall be added to or deducted from payments to the contractor.

(e) (1) If the time for performance of this contract is legally extended by the contracting officer, there shall be immediately set up by the contractor, subject to the approval by the contracting officer, new monthly cost quotas as necessary. These new monthly cost quotas may extend back as far as any month for which adjustments in payments have not been completed, but the total of the new quotas shall not exceed the total of the old quotas for which adjustments in payments have not been completed.

(2) If there is an increase or decrease in the work originally contemplated under this contract, there shall be immediately set up by the contractor, subject to the approval of the contracting officer, new monthly costs quotas for months concerned.

(3) If liquidated damages are assessed against the contractor under the contract, such liquidated damages shall not be considered in making adjustments.

(f) The adjustment payment or deduction for any one month shall normally be included with next partial contract payment after receipt of Department of Labor indices for such month.

(g) The acceptance and final payment for work and/or materials under this contract shall be carried out as elsewhere provided in this contract, and amounts retained for the protection of the Government during construction shall be promptly paid upon final acceptance: Provided, however, that an amount, as determined by the contracting officer, for protection of the Government in adjustments not yet completed, shall be retained; and, provided further, that the release required by______________ ________________will contain provision excepting such adjustment payments as may become due the contractor.

(h) After final payment for basic contractual price as indicated in paragraph (g) above has been made, adjustments becoming due will be delayed until all indices necessary for completion of all adjustments under the contract are available, when one lump payment or deduction shall be made for such adjustments.

(i) In case the final adjustment in the contract price results in a net deduction from the contract price, the contractor and his sureties shall be liable for the amount thereof until it is refunded to the Government.

(j) When payment obligations under the contract exceed the contract price as a result of increases in labor and/or materials costs to the extent that available appropriations are exhausted, the Government reserves the right, without further liability to suspend further work under the contract for the account of the Government or to terminate the contract on payment of contractual obligations incurred up to the point of termination.

1-46. FINAL EXAMINATION AND ACCEPTANCE. - When all work called for under this contract has been completed, the contracting officer will make a thorough examination of the same and, if it is found to comply fully with the requirements of the contract, it will be accepted and final payment will be made in accordance with the provisions of Article 16d of the contract.

1-47. APPROVAL. - This contract shall be subject to the written approval of the proper authorities to be designated later and will not be binding until so approved.

## SECTION II - EXCAVATION, FOUNDATION PREPARATION, AND GROUTING

2-01. CLEARING AND GRUBBING.

(a) The work area as shown on the drawings shall be cleared according to the following:

(1) The excavation area plus a strip 50 ft. wide outside of the top of cut, except as otherwise required, for the construction of the lock and approach channels shall be cleared of all trees, brush, fences, buildings and any other objectionable material as directed by the contracting officer.

(2) In areas to be covered by spoil, trees shall be cut off at elevations not higher than 4 feet below top of spoil dump.

(3) The foundation areas of embankments for Class I and Class II compacted earth fills, filter blankets and rock protection shall be cleared and grubbed of all trees, stumps, roots, brush, fences, buildings, and any other objectionable materials. In foundation areas to be stripped as shown on the contract drawings, all roots 1½ inches in diameter or greater shall be grubbed to a minimum depth of 4 feet below the ground. Trees in 50 ft. wide strips outside the toe of all embankment slopes, except as otherwise required, shall be cut off at elevations not higher than 2 feet above ground surface.

(4) All work areas upstream of the North and South Dikes below elevation 250 m.s.l. shall be cleared of trees, brush, fences, buildings, and any other objectionable material. Trees shall be cut off 2 feet above the ground surface except that no stumps shall remain above elevationn 235 m.s.l. Trees above elevation 235 shall be cut flush with the ground, except as otherwise provided.

(5) All work areas downstream of the North and South Dikes below elevation 250 m.s.l. shall be cleared of trees, brush, fences, buildings and any other objectionable material. Trees shall be cut off 2 feet above the ground surface except that no stumps shall remain above elevation 231 m.s.l. Trees above elevation 231 shall be cut flush with the ground, except as otherwise provided.

(6) Portions of the designated areas actually developed for borrow excavation shall be cleared of all trees, stumps, brush, fences, buildings and any other objectionable materials or structures.

(b) All material from clearing and grubbing shall become the property of the contractor and he shall destroy, remove from the site of the work, or otherwise dispose of it as approved by the contracting officer.

(c) No separate payment will be made for clearing and grubbing, but the cost of doing such work shall be included in the contract unit prices for other items of work.

2-02 EXCAVATION REQUIREMENTS. - Excavation shall be carried to the lines and grades shown on the drawings or as directed by the contracting officer. Excavation and foundation preparation for the various sections of the Lock and Dikes shall be performed in accordance with paragraphs in this section of these specifications, or as otherwise directed by the contracting officer.

2-03 CHARACTER OF MATERIALS TO BE EXCAVATED. - The location and logs of borings, test trenches, and test pits referred to in paragraph 1-17(a) made by the United States to determine the character of materials to be encountered and removed or to be used in the earth embankment are shown on the drawings or are available for inspection at the U. S. Engineer Office, Massena, New York. It is expected that large boulders may be encountered in some portions of the excavations which cannot be removed without blasting. The United States does not guarantee that other materials will not be encountered nor that the proportions of the several materials will not vary from those indicated by the explorations. (See paragraph 1-17(a).)

## 2-04. CLASSIFICATION OF EXCAVATION.

(a) Rock Excavation. - All bedrock required to be excavated which in the opinion of the contracting officer cannot be removed without continuous and systematic blasting, barring, or wedging, and all boulders and loose rock two cubic yards in volume or greater will be classed as rock excavation.

(b) Common Excavation. - All other material from structure foundations, canal or approach channel excavations will be classified as common excavation, including boulders and loose rock less than two cubic yards in volume.

(c) Borrow Excavation. - Authorized excavation of material from designated borrow areas for use in embankment construction will be classified as borrow excavation.

## 2-05. REMOVAL AND DISPOSAL OF EXCAVATION.

(a) Removal. All materials shall be removed to the lines and grades as indicated on the drawings, or as otherwise required by the contracting officer, to provide suitable structure foundations, suitable canal and approach channel sections, and to obtain suitable materials for embankment construction, as specified below. The contractor may excavate for structure foundations and for the canal and approach channels by dredging or dry land excavation methods or by any combination thereof within the requirements of the specifications and drawings. Prior to commencement of work and at intervals of not less than 60 days thereafter during the progress of the work the contractor shall submit a plan satisfactory to the contracting officer indicating the equipment, methods, and procedure he proposes to use.

(1) Excavation by Dredging. - In areas where he elects to excavate by dredging, the contractor shall provide all channels, basins, dikes, pumping facilities, waste weirs, and other works required for placing his dredges on the site of the work, create and maintain flotation pools of adequate depth, excavate and dispose of all materials as required herein, and remove his dredges from the site of the work. In connection with all dredging operations, he shall control his waste paper so as to avoid damage to the activities of other contractors and the public at large. Location, size and type of waste weirs shall be subject to the approval of the contracting officer. The cost of all such work shall be included in the contract unit price for excavation. Dredging of side slopes shall be conducted so as to produce minimum undercutting. The contracting officer will prescribe the maximum allowable depths of undercutting wherever he considers that the material being excavated is of such nature that slides extending beyond the limits of the specified side slopes might result from excessive undercutting.

If a dredge access channel is excavated from the river to the lock site, the plug shown on the drawings across the lower approach shall be rebuilt and the highway reconstructed immediately after passage of the dredge. The dredge access channel across this plug shall be held to the minimum practicable dimensions. Replacement of the plug fill and highway shall be as directed by the contracting officer and shall be completed within a reasonable period of time to be stipulated by the contracting officer. No separate payment will be made for the dredge access channel excavation or for replacement of plug fill and the highway. All subsequent passages of the dredge through the plug shall be conducted in accordance with the above, until such time as the permanent highway across the dikes and lock is completed and opened to traffic. After completion of this highway the plug across the approach channel shall be removed and payment will be made at the contract price for common excavation.

(2) Excavation in the Dry. - Where he elects to excavate in the dry the contractor may use such methods as he desires provided undercutting of slopes does not exceed the maximum allowable depths prescribed by the contracting officer and provided the excavated materials suitable for embankment construction are effectively separated from materials unsuitable for embankment construction. No separate payment will be made for pumping, construction of ramps, trestles and roads, rehandling of excavated materials, or any other work incidental to the excavation and disposal of materials as specified herein, all costs of which shall be considered included in the contract price for excavation.

(3) Slides. - Any slides occurring in required excavation shall be removed to the lines and grades directed by the contracting officer. If such slides occur through no fault of the contractor, the work of removal and disposal of slide materials will be paid for at the contract unit price for common excavation. If the slides occur as a result of excessive undercutting of banks or any other fault of the contractor, as determined by the contracting officer, the slide materials shall be removed and disposed of without extra cost to the United States.

(4) Borrow Excavation. - Borrow areas are shown on the drawings. The contractor shall obtain suitable materials from these areas to the extent required for completion of the compacted fill embankments , as determined by the contracting officer. Unless otherwise approved by the contracting officer, excavation in borrow areas shall not be carried below El. 255. It is estimated that in the required excavation and in the designated borrow areas there is sufficient quantity of suitable material for the compacted fill embankments. The contracting officer will specify the location at which borrow excavation shall be made within the borrow areas. The specified areas shall be cleared and grubbed as specified in par. 2-01 and stripped as required to remove unsuitable material as directed by the contracting officer. The depths of cuts and lifts and the disposition of the excavated materials may require the contractor to change the locations and depths of his excavating operations whenever such change is, in the opinion of the contracting officer, necessary to obtain the proper quality of material. The excavations shall be worked so that the materials are mixed in the process of excavation. Excavation shall be in a manner to produce drainage of the material if the ground water table is above the elevation of the excavation. After the excavation is completed,

excavated surfaces shall be graded to a smooth and pleasing appearance as directed by the contracting officer and each borrow area shall be so graded that the final surface area shall blend into the surrounding topography and all surface water will readily drain therefrom. The contractor shall construct and maintain all connecting roads required from the borrow areas to the place of disposal and no separate payment will be made therefor.

(5) Excavation in Stock Piles. - Earth fill materials from stock piles shall be obtained in manner satisfactory to the contracting officer. The contractor will be required to excavate in the areas directed by the contracting officer and change the locations and depths of excavating operations wherever such a change is directed by the contracting officer. The final surfaces of the remaining part of parts of the stock piles of earth fill shall be graded and blended into the surrounding topography in a manner satisfactory to the contracting officer.

Rock materials from stock piles shall be obtained in a manner satisfactory to the contracting officer. After the excavation of the stock pile of rock is completed, the remainder of the material shall be gathered and neatly piled as directed by the contracting officer. No separate payment will be made for rock excavation in quarries or stock piles.

(6) Stripping for Dike Embankments. - Excavation for the embankments (See paragraph 3-01) shall be carried to the lines and grades, and slopes as shown on the contract drawings or as directed by the contracting officer. The contractor shall be required to de-water all excavation areas to produce a dry condition suitable for placing embankment as determined by the contracting officer. Should excavation be required to a higher or lower elevation than that indicated on the drawings, as determined by the contracting officer, no change will be made therefore in the contract unit prices.

(b) Disposal. - The excavated materials shall be disposed of as follows, unless otherwise directed by the contracting officer.

(1) Materials Excavated for Concrete Structure Foundations and for the Canal and Approach Channels. - All material excavated for the construction of the concrete structures and approach channels which is suitable, as determined by the contracting officer, for the compacted fill embankments, shall be placed directly in the embankments or in stock pile areas approved by the contracting officer. All material not suitable for the embankments shall be disposed of in the spoil areas shown on the drawings in the manner specified in paragraph 2-05(b)(4) below.

Rock obtained during the excavation for concrete structures which passes the specifications for riprap (See paragraph 3-08) shall be placed directly in the rock fill section of the dikes, in areas adjacent to the lock where protection stone is required (See drawings), or in stock piles. All rock except shale in excess of that required for the riprap for the work included under this contract shall be stockpiled in areas and in a manner approved by the contracting officer.

(2) Materials Excavated from Borrow Areas and Stock Piles. - Materials excavated from borrow areas which are suitable, as determined by the contracting officer, for use in compacted fill embankments shall be placed directly in such embankments. Materials from stripping or other unsuitable materials shall be deposited in the designated spoil areas as specified in paragraph 2-05(b)(4) below or may be wasted in previously excavated borrow pits if placed and graded as

directed by the contracting officer for proper drainage and neat appearence. Suitable materials excavated from stock piles shall be placed directly in embankments.

(3) Materials Excavated for Embankment Foundations. - Materials stripped from foundation areas for compacted fill embankments shall be wasted i the designated spoil areas, as specified in paragraph 2-05 (b) (4) below.

(4) Spoil. - It is expected that a large volume of material from the required excavations for structure foundations, the canal and approach channels is unsuitable for compacted fill embankments and will have to be wasted. In general this material is described on the records of exploration as soft brownish or grey clay and extends for various depths below the ground surface. Excavated materials determined by the contracting officer as unsuitable for us in compacted fill embankments shall be deposited in the spoil areas shown on the drawings. Except as otherwise shown on the drawings the top of spoil dumps upstream from the dikes shall be at El. 237 or at El. 247 or higher, and the top of spoil dumps downstream from the dikes shall be at El. 235 or lower or at El. 245 or higher. Spoil dumps shall be built so that their slopes facing the canal will present straight line contours parallel to the spoil control lines i dicated on the drawings. The spoil control line is a definite line for the purpose of establishing the position of the front slope at a definite elevation, thus making the front slope a plane surface. All dumps shall be leveled off o top and graded on the side and end slopes to give proper drainage and present a orderly and finished appearance. No dump shall be built with front, rear or en slopes steeper than 1 vertical on 3 horizontal. The front slope of dumps shall be kept as uniform as practicable. In spoiling dredged material the contractor shall be responsible for all damages which may ensue as a result of the escape waste water or dredged material. Wherever practicable te water from dredgin shall be conducted back into the excavation within the limits of his operation The location of all temporary dikes and waste weirs shall be subject to the approval of the contracting officer and the cost of all such works necessary to confine the dredge materials within the designated spoil areas shall be include in the contract unit price for excavation. The filling of any spoil area shall proceed continuously as far as practicable. Dredged material shall not be permitted to run or spread into the St. Lawrence River except within the designate spoil areas shown on the drawings. No natural water courses shall be obstructe without measures satisfactory to the contracting officer being taken by the con tractor. The contractor shall provide any necessary drainage facilities to dra water pockets formed by his operations.

## 2-06. MEASUREMENT AND PAYMENT FOR EXCAVATION.

### (a) Measurement.

(1) A survey of the ground surface and river bottom for foundation, canal, approach channel, and borrow excavation will be made prior to commencement of work and measurements of excavation will be based on this survey and on the classifications specified in par. 2-04. Stripping wi be classified and measured as common excavation. Measurement for common excavation will be made between the ground surface and the slope and grade lines sh on the drawings or as modified by the contracting officer, or to the natural ro surfaces encountered in such excavation. Measurement for borrow excavation wil be made between the original ground surface and the actual grades and lines to which excavation is carried within the limits shown on

the drawings and specified herein or as otherwise authorized by the contracting officer. No measurement will be made for borrow excavation other than that specifically authorized by the contracting officer.

(2) A survey of all stock piles will be made prior to the start of excavation operations. Measurement of excavation for embankment materials for payment will be based on this survey, and a final survey of the completed excavation.

(3) Measurement for rock excavation will be made for the actual quantity excavated within the slope, structure, and grade lines shown on the drawings, or such modifications of these lines as directed by the contracting officer. No payment will be made for any rock excavation carried below or beyond these lines by unecessary drilling and blasting and all rock thus removed, shall be replaced with concrete at the expense of the contractor.

(4) The excavation payment slope lines shown on the drawings do not represent actual slopes necessary and are not guaranteed by the Government as safe slopes for making the required excavations. The actual slopes required for safety shall be as determined by the contracting officer. Unless otherwise directed or authorized the actual slopes shall not be steeper than those shown.

(b) Payment.

(1) Payment for all required foundations, canal, and approach channel excavation shall include the cost of transportation and disposal as required under paragraphs 2-02 and 2-05 and will be made at the applicable contract unit prices per cubic yard for "Excavation; Common", and "Excavation; Rock."

(2) Payment for common excavation which, in the opinion of the contracting officer, cannot be removed by a 2½ cubic yard power shovel without continous and systematic blasting will be made at twice the contract unit price per cubic yard for "Excavation; Common."

(3) Payment for earth embankment materials excavated from the designated borrow areas, including material stripped from the surface; will be made at the contract unit price per cubic yard for "Excavation Borrow", which prices shall include all costs of draining, excavating, transporting and dumping the suitable fill material and disposing of unsuitable material as provided herein, and the cost of all operations attendant thereto. No payment will be made for borrow excavation other than that specifically authorized by the contracting officer.

(4) Where stockpiling of excavated material prior to its incorporation in fill is directed by the contracting officer, separate payment will also be made for stockpiling at the rate of 50 percent of the respective contract unit price for excavation; provided, however, that no payment will be made for stockpilling when and where the contractor is offered the alternative of suspending excavation but elects to stockpile in lieu of suspension. The alternative of suspending excavation will be offered only when and to he extent that in the opinion of the contracting officer progress has been such as to warrant it. Such offer shall not constitute a basis for extension of time limit under the contract. No separate payment will be made for stockpiling spoil. Excavated materials piled adjacent to the excavation for later use as backfill therein will not be considered stockpiles.

## 2-07. PREPARATION OF FOUNDATION FOR CONCRETE STRUCTURES.

Rock.- Foundation excavation for the lock structure shall be carried to sound, firm ledge rock, free from open horizontal seams or disintegrated portions. Blasting against surfaces which will form the final surface will not be permitted, (See paragraph 2-10). The foundation shall be prepared by barring, picking, wedging, or similar methods which will leave the rock of the foundation in an entirely sound and unshattered condition. The surface of the rock shall be left clean and rough to provide a proper bond between the rock and the concrete. All water shall be removed from the final foundation, which shall be moistened as required by the contracting officer prior to initial placement of grout. The contractor will be required to drill exploratory core holes as directed in paragraph 2-10 in the foundation to determine the suitability of the bedrock. Payment for rock foundation preparation will be included in payment for rock excavation.

2-08. LINE DRILLING.

(a) The vertical rock faces indicated on the drawings or as otherwise required by the contracting officer shall be made with a channeling machine, by drilling and broaching or by close line drilling. Rock excavation adjacent to channeled faces shall be removed in shallow lifts and short sections, and the channeled face remaining shall be of undisturbed rock.

(b) Measurement for line drilling will be made along the vertical surface indicated on the drawings or established by the contracting officer. Payment for channeling, drilling and broaching or close line drilling will be made at the contract unit price per square foot of vertical surface for "Line Drilling". Payment for the rock removed will be made as specified in Par. 2-06.

2-09. BLASTING FOR EXCAVATION. - Blasting will be permitted only when proper precautions are taken for the protection of all persons, the work and property, and any damage done to the work or property by blasting shall be repaired by the contractor at his own expense. Caps or other exploders or fuses shall in no case be stored or kept in the sameplace in which dynamite or other explosives are stored. All operations of the contractor in connection with the transportation, storage and use of explosives shall be subject to the approval of the contracting officer, and the contractor shall be liable for all injuries or deaths of persons or damage to property caused by blasting or explosives. All necessary precautions shall be taken to preserve the rock outside the lines of excavation in sound condition. Blasting may be done only to the depth, amount and extent approved by the contracting officer. Approval of the method of blasting by the contracting officer, as specified in this subparagraph will not relieve the contractor of his responsibility in blasting operations, and no payment will be made for any rock required to be excavated outside of the limit lines indicated on the drawings or below the grade lines established in the field, or modifications thereof directed by the contracting officer, solely due to injury caused by the overshooting, improper blasting or carelessness on the part of the contractor, and all rock thus removed shall be replaced by concrete at the expense of the contractor, including the payment for all cement used in such concrete and furnished by the United States. No blasting shall be done within one hundred(100) feet of the concrete which has been in place less than seven (7) days.

2-10. DRILLING EXPLORATORY AND GROUT HOLES.

(a) General. -For the purpose of canvassing bids, the approximate extent of a tentative program for drilling exploratory and grout holes is outlined herein. The Government reserves the right, however, to alter the exploratory and grout holes, and no change will be allowed in the contract unit prices because of such alterations. The contractor shall, at the applicable contract unit prices, drill exploratory and grout holes at such locations and at such inclinations not to exceed twenty ( 20) degrees from the vertical, and to such depths, subject to the limitations hereinafter specified, as may be required by the contracting officer.

(b) Method of Rock Core Drilling. - Core drilling through rock shall be done with standard core drilling equipment using diamond or alloy bits designed to furnish complete standard cores a minimum of 2 inches in diameter from holes 3 inches in diameter. The contractor shall run his drills at such speeds as will insure satisfactory core recoveries, and the contracting officer may require, without compensation, the redrilling of those holes from which the cores are unsatisfactory if the contractor's operations are at fault.

(c) Exploratory Core Holes. -The rock foundations area covered by the lock structure and areas adjacent thereto shall, after removing overburden, be further explored by rock core drilling. These holes in the foundation rock are intended to determine the location of suitable rock for the foundation of the lock structure. It is expected that at least one drill hole will be required in the foundation of each concrete monolith founded on rock, as shown on the drawings, and the quantity estimated for bidding purposes is based on this extent of drilling. However, the contracting officer may direct that additional holes be drilled under each monolith or at other locations. The depth of these holes shall be 20 feet or more, as directed by the contracting officer. Concreting shall not be commenced in any section until after the contractor has received written approval of the foundation for placing concrete for each monolith.

(d) Grout Holes. - Holes shall be drilled at intervals and to depths hereinafter specified across the upper and lower emergency dam sills and both upper and lower miter gate sills. These holes shall be drilled after a minimum height of 10 feet of concrete has been placed. The holes through concrete may be obtained by percussion drilling or by placing 4 inch pipe as directed by the contracting officer prior to concreting. The holes in the rock shall be obtained by core drilling as specified in subparagraph (b) above. The contractor will be required to protect the concrete surfaces during all drilling and grouting operations and no separate payment will be made for such protection. When the drilling of each hole has been completed, the hole shall be protected from being clogged or obstructed until it is grouted. Any hole that becomes clogged or obstructed prior to grouting shall be opened up to the satisfaction of the contracting officer, and no separate payment will be made therefor.

(e) Rock Cores. - Core boxes for storing the 2 inch cores from exploratory and grout hole drilling, shall be furnished at the site by the contractor. All samples shall be in the custody of the contractor until transported from the site by a representative of the contracting officer, and while in his custody shall be protected from the weather. All boxes shall be of pine or similar soft lumber of lightweight, non-warping and capable of holding screws without splitting. They shall be neatly and substantially constructed with suitable partitions with the top of the box hinged and with suitable fastners. Partitions in the boxes shall run lengthwise, be securely fastened and shall be approximately 1/8 inch farther apart than the diameter of the rock core to be placed in the box. Spacers to separate the rock core obtained by each run shall be soft wooden blocks to fit between the core box partitions and shall be 1-1/2 inchesin length. The core boxes shall be of uniform size 4 feet in length, and approximately 12 inches wide, and shall meet with the approval of the contracting officer. All cores shall be neatly arranged in the sequence in which they are removed from the hole, and be properly identified.

(f) Filling Exploratory Holes with Grout.- All exploratory holes shall be filled with grout consisting of sand and cement of such mixtures as determined by the contracting officer. Sand for grouting shall be as specified in par. 2-11 (d). The holes shall be filled with grout by means of equipment for pressure grouting as described in par. 2-11 (c). In filling the exploratory core holes no pressure tests are required and the hole being filled shall not be sealed.

(g) Measurement and Payment.

(1) Measurement for payment of grout holes in concrete will be from the concrete surface to the foundation rock surface. Measurement for payment for holes in rock will be from the foundation rock surface to bottom of hole. Payment for drilling grout holes in concrete or placing pipes will be made at the contract price per linear foot for "Drilling Grout Holes in Concret Payment for drilling grout holes in rock will be made at the applicable contrac price per linear foot for "Drilling Grout Holes in Rock", which payment shall include drilling, pressure testing, protection of the completed hole and all costs in connection therewith.

(2) Measurement for payment of exploratory holes in rock will be from the foundation rock surface to bottom of hole. Payment for drilling exploratory holes in rock will be made at the applicable contract price per linear foot for "Drilling Exploratory Holes in Rock", which payment shall include drilling, protection of completed hole, grout filling and all costs in connection therewith.

(3) Core boxes that are required to store cores from grout holes and exploratory holes will be paid for at the contract unit price each for "Core Boxes", which payment shall include all costs of transportation and storage in connection therewith.

2-11 PRESSURE GROUTING FOUNDATION. -

(a) Pressure Testing. - Before any hole is grouted it shall be pressure tested with water for leakage at intervals as directed by the contracting officer throughout the full depth of the hole. The contractor shall furnish the necessary equipment and make the tests. The equipment shall provide capacity sufficient to test the grout holes at pressures up to 150 pounds per square inch. A suitable gage shall be installed in the pressure line at the hole being tested so that pressures in the hole will be indicated at all times. A water meter reading directly to a 0.1 cubic foot per minute shall be installe in the pressure line to measure the leakage from the hole. The pressure shall be varied with the depth at the direction of the contracting officer. From the test results, the contractor shall furnish information indicating the location and amount of each leakage. Payment for pressure testing will be made at the contract unit price per test for "Pressure Test, Grout Holes".

(b) Procedure.

(1) The line of grouting holes shall be drilled at intervals of 20 feet across the sills and base widths of adjacent walls. The holes shall be drilled and cores recovered, as specified above, to a depth of 25 feet or more into the rock as directed by the contracting officer. These holes shall be pressure tested as specified in paragraph 2-11 (a) above.

(2) All the holes shall next be thoroughly washed out and grouted according to the procedure specified in paragraph 2-11(e). Should seams connec between any adjacent grout holes these holes shall be interconnected and simultaneously washed and then simultaneously grouted. If more than three hole join any one seam, seals and connections will be required, of a design approved by the contracting officer, to simultaneously grout the holes.

(3) After the grout holes on 20 foot centers have been satisfactorily grouted and not sooner than 48 hours thereafter, test holes shall be drilled midway between and to the same depth as the adjacent 20-foot holes. These test holes shall be drilled, tested, and if found to leak more than approved by the contracting officer, they shall be grouted by the same method as the holes on 20-foot centers.

(4) This method of drilling and grouting shall continue until the grouting has been accepted as completed, i.e., when a hole is drilled and found necessary to grout, holes shall be drilled each side of the grouted hole at one-half the previous interval, and the same testing, washing, and grouting procedure shall be followed until not more leakage is observed or as otherwise directed by the contracting officer.

(c) Grouting.

(1 ) Equipment to be Used.- The equipment to be used for mixing and injecting the grout shall be subject to the approval of the contracting officer. The grouting unit shall provide:

a. A grout mixer for mixing the ingredients.

b. A suitable water meter with straight-reading register reading to the nearest 0.1 cubic foot for measuring the mixing water.

c. A water tank for auxiliary water supply to be used for pressure testing, flushing pumps, lines, and hole.

d. A mechanically agitated sump to prevent the segregation of ingredients after mixing and to maintain a supply during the mixing period.

e. Two duplex displacement grout pumps so piped and assembled as to provide interchangeable, continous, and effective injection to grout at any desired pressure, not to exceed 250 pounds per square inch.

f. Air compressors of suitable capacity, water pumps, and auxiliary equipment. The mixer and sumps shall each have a volume of not less than 15 cubic feet. The assembled unit shall allow the injection of 150 cubic feet of solids per hour at 150 pounds per square inch pressure, if desired. The grouting equipment shall be maintained in a manner satisfactory to the contracting officer and so as to insure continuous and effective performance during any grouting operation. Circulation grout lines shall be not less than 1-1/2 inches in diameter and are to be controlled by suitable valves in the header and piping so that all or part of the grout can be injected into the hole, or all or part returned to the sump. A suitable pressure gage shall be provided at the hole as well as at the pump for indicating the pressure during the injection of grout. The pressure gage shall be installed in the header near the hole being grouted and by passing of the grout back to the sump tank shall be near the hole being grouted and not at the machine. Grout stops or packers and hole connections are to be provided which shall consist of a double sealing unit 5 feet long. The expanding seals at each end shall be composed of rubber and have a length of 6 inches by 3 inches in diameter as directed by the contracting officer. Miscellaneous calking tools and hammers and necessary labor for calking shall be furnished by the contractor as directed by the contracting officer .

(d) ,Composition of Grout and Method of Placement.- Grout shall consist of a mixture of neat Portland cement and water in proportions as directed by the contracting officer, or sand or rock flour may be mixed with grout in proportion not to exceed 1 part cement to 3 parts sand or rock flour. The type and mixture of grout to be used will be determined by the nature of the seams to be grouted and as directed by the contracting officer. Sand, if used, shall be furnished by the contractor and shall be of such fineness that 100 percent will pass a No. 28 standard sieve and 25 percent will pass a No. 100 standard sieve. Cement for grouting will be furnished by the Government in paper bags (See paragraph 1-10(d) ). Prior to pressure grouting, all grout holes shall be sounded and, if necessary, shall be thoroughly washed and cleaned with water under continuous pressure or by compressed air and water in an manner which will permit free overflow of waste water, by inserting a smaller pipe and introducing the wash water at the bottom of the hole. The speed of operation of the grout pump and the grouting pressure will be as directed by the contracting officer. In general, it is expected that pressures up to 150 pounds per square inch will be required for the deeper sections of the holes, while lower pressures will be used for the upper zones. Grouting shall be continued until the hole takes the grout mixture at a rate of less than one cubic foot in 10 minutes under the required grouting pressure, and the grouting of any hole shall be discontinued when directed by the contracting officer. The contracting officer may require that the grouting of any holes may be temporarily suspended if wor is proceeding in an unsatisfactory manner, and the hole protected by suitable means until grouting is resumed. In the event of an unavoidable delay during grout injection, the contractor shall supply water at not less than the specified grouting pressure for application to the hole as directed by the contracting officer. When the grouting of any hole has been commenced, it shall be continued until completion, unless otherwise directed by the contracting officer. After grouting operations for any hole have been completed and the grout set, or if the rock about any hole is in such sound condition that pressure grouting is not necessary, the hole shall be completely filled with grout. When a hole during the grouting procedure shows back pressure it shall be capped or otherwise sealed.

(e) Payment.

(1) Payment for grouting will be made at the contract unit price per cubic foot for "Pressure Grouting". The volume of grout will be considered to be equal to the volume of cement plus the volume of sand or rock flour used measured in the loose dry state. This payment shall include washing and jetting of grout holes, equipment, and labor necessary, except that cement will be furnished by the United States. No payment will be made for grout lost due to improper anchorage of grout pipes or connections, nor for grout rejected by contracting officer because of the improper mixing.

(2) Payment for sand or rock flour used in grouting will be made at the contract unit price per cubic foot for "Sand in Grout" or "Rock Flour in Grout."

## SECTION III

## EMBANKMENTS, BACKFILL AND PROTECTION STONE

3-01. DEFINITION. - The term "Embankments" as used in this section includes the earth fill of dikes; the compacted earth backfill behind the lock and approach walls; highway fill, the sand and gravel backing, riprap protection, and filter blankets of dikes, and all other specified or directed fill and slope protection.

3-02. GENERAL PROVISIONS. -

(a) Lines and Grades. - The embankments shall be constructed to the lines and grades shown on the drawings or otherwise required by the contracting officer. The contracting officer reserves the right to change the foundation widths, change the slopes and dimensions of the embankments, change the dimension and slopes of the foundation cut-off trenches and change the slope and thickness of the dumped riprap protection and make such other changes as future studies and conditions on the work indicate as necessary for the construction of a safe and permanent structure as determined by the contracting officer. Changes in quantities of materials resulting from changes in sections shall be no cause for claims for increase in the contract unit prices.

(b) Materials. - Materials for the various sections of the embankments shall conform to the respective requirements specified in the following paragraphs of this section. No brush, roots, sod, and perishable or objectionable materials, as determined by the contracting officer, shall be placed in the compacted embankments. Any objectionable material placed in the compacted embankments shall be removed by the contractor as directed by the contracting officer, without cost to the Government. The suitability of each part of the foundation for placing embankment materials thereon and of all materials for use in an embankment will be determined by the contracting officer. No materials shall be placed in an embankment where either the materials orthe foundation on which they are to be placed is frozen.

(c) Conduct of the Work. The contractor shall at all times maintain the embankments in conformity with paragraph 3-04(c) and in a manner satisfactory to the contracting officer until the final completion and acceptance of all work under the contract. The contractor may be required to suspend work at any time when, in the opinion of the contracting officer, satisfactory work cannot be done on account of rain, floods, cold weather, or other unsatisfactory conditions. Any approved embankment material which is lost or rendered unsuitable after being placed in an embankment and before the completion and final acceptance of the work, due to causes that, in the opinion of the contracting officer, are avoidable, or under the control of the contractor, shall be replaced by the contractor in a manner satisfactory to the contracting officer and without cost to the Government. The contracting officer may require the contractor to remove without cost to the Government any material placed by the contractor outside of specified slope lines.

(d) Order of Work. - The contractor will be required to organize the work so that suitable rock and earth fill materials obtained from the excavation for the construction of the lock structure may be placed directly in the embankment sections, where practicable.

## 3-03. PREPARATION OF FOUNDATION FOR EMBANKMENT. -

(a) General - The foundations for the embankments shall be stripped and excavated as specified in Section II. The test pits, stump holes and other excavated areas, depressions and cavities within the limits required to be stripped shall be filled with compacted earth as directed by the contracting officer. The earth fill shall be placed in layers, moistened and compacted in accordance with paragraph 3-04. As the fill is brought up, the side slope of the cut or hole shall be scarified, if in the opinion of the contracting officer, it is required, in order to provide a bond between the fill and the original ground material. The sides of all holes shall be broken down if necessary so as to flatten out the slopes, and the hole then filled with approved material and properly rolled or tamped in place. Immediately prior to placing Class I and II materials in embankments. the entire foundation, except areas to be covered by sand and gravel filter, shall be scarified to a depth of 4 inches. A 4-inch layer of embankment material shall be spread and compacted as specified for Class I fill in paragraph 3-04(e). The foundation upon which fill is placed shall be in a suitable dry condition, as determined by the contracting officer.

(b) Measurement and Payment. - Payment for the fills in the foundation areas indicated above, including the spreading, rolling and wetting where required will be made at the applicable contract unit price per cubic yard for "Earth Fill; Compacted Class I, and "Earth Fill; compacted, Class II". No payment as a seperate item will be made for other work necessary for the preparation of the foundation including the dewatering in the foundati areas of the embankments, but the cost of these items shall be included in the contract unit prices for the other items of work connected with the embankment.

## 3-04. CLASS I AND CLASS II COMPACTED EARTH FILLS. -

(a) Material. - Materials for the Class I and Class II compected earth fills shall be secured from the excavations for the lock, canal and approach channels and from authorized borrow (see Section II). The materials in general will be sand and gravel or well graded clayey or silty gravelly sand. No stones which would be retained on a 6-inch screen will be permitted in the Class I compacted earth fill. No stones which would be retained on an 8-inch screen will be permitted in the Class II compacted earth fill. Should stones of such size be found in the otherwise approved materials, they shall be removed by the contractor. Suitable stones removed may be used for riprap as specified in paragraph 3-07. Each load of material to be placed in either Class I or Class II compacted earth fill shall be the equivalent, as nearly as practicable, of a mixture of materials obtained from an approximately uniform strip or cutting from the full height of a life in excavation. The combined excavation and embankment placing operations shall be such that the materials when compacted in the fill will be blended sufficiently to secure the greatest homogeneity and desired density.

(b) Placement. - The distribution and gradation of materials throughout the Class I and Class II compacted earth fill section of the embankments shall be such that the embankments will be free from lenses, pockets, streaks or layers of materials differing materially in texture or gradetion from the surrounding materials. The dumping of successive loads of fill materials from the different parts of the required excavations shall be at locations in the embankment as directed by the contracting officer, and for this purpose, the contracting officer may direct the points in the embankments where individual loads of material shall be deposited to the end that the more pervious material shall be placed in the outer exposed sections of the Class II compacted earth fill. After dumping, the materials shall be spread by bulldozers or other approved methods in approximately 8-inch layers over the prepared foundation or fills. Materials in areas where compacting by rolling is impracticable, as determined by the contracting officer, shall be spread in layers 4 inches in thickness before compacting. All layers shall extend at an approximately uniform elevation over the width of the embankment and for the entire length of the section under construction unless otherwise directed by the contracting officer. The top surfaces of the Class I and Class II compacted earth fills during construction shall be kept crowned with grades not less than 2 nor more than 4 percent, so that the surface of the fill will drain freely toward the slopes. If work is stopped on any part of the Class I compacted earth fill for a period of time, the area to remain standing shall be rolled with a smooth-faced roller to prevent loss of moisture and to facilitate drainage. If, in the opinion of the contracting officer, the rolled surface of any layer of any section is too smooth to bond properly with the succeeding layer or adjacent section, it shall be roughened or loosened by scarifying to the satisfaction of the contracting officer before the succeeding layer is placed thereon. Ruts in the surface of any layer shall be filled in a manner satisfactory to the contracting officer.

(c) Moisture Control. -

(1) The materials in each layer of the Class I and Class II compacted earth fills while being compacted shall contain moisture within a few percent of the optimum, as determined by the contracting officer, for the compaction desired. Prior to and during construction, the contracting officer will establish the limiting ranges of moisture contents for materials to be compacted in Class I fill and Class II fill. The moisture content shall be uniform throughout the layer. If the application of water is necessary, it may be done either at the excavation area or at the embankment. Wetting at the excavation area shall be supplemented as required by sprinkling in place on the embankment, if in the opinion of the contracting officer it is necessary. The contractor shall maintain adequate facilities to provide the amount of water required.

(2) No layer of material shall be placed if the moisture content of the exposed surface on which it is to be placed is not within the range established by the contracting officer. The contractor shall correct the moisture content of the compacted layer if the moisture content is not within the required limits.

(d) Compaction. - Class I and Class II compacted fill shall be rolled and compacted with the equipment listed in paragraph 3-04(e) below. Each layer of Class I fill shall be compacted by not less than 6 passes or trips and each layer of Class II fill shall be compacted by not less than 2 passes or trips, of a sheepsfoot roller. In areas where rolling operations are impracticable as determined by the contracting officer, compaction shall be obtained with power tampers of a type approved by the contracting officer to give compaction equal to that required for the adjoining compacted earth fill. Each pass of a roller shall overlap the adjacent rolled area by at least 2 feet. If the moisture content is greater or less than that required for compaction, the rolling or tamping shall be delayed until the proper moisture content as determined by the contracting officer has been reached.

(e) Equipment for Compaction by Rolling. - Equipment consisting of an oscillating double section sheepsfoot tamper roller, pulled by a crawler type tractor weighing not less than 20,000 pounds and which is weighted or equipped with a bulldozer, or both, to increase its total weight to not less than 29,000 pounds, shall be used for compacting Class I fill. The use of more than 2 rollers in tandem will not be permitted. The design and operation of the compacting equipment shall be subject to the approval of the contracting officer. The speed of the compacting equipment shall be not more than 2½ miles per hour. Each drum of the oscillating double section sheepsfoot tamper roller shall be approximately 4 feet in width and shall have tamping feet uniformly staggered over its cylindrical surface and be provided with cleaners Each tamping foot shall project approximately 7 inches from the rollers's cylindrical surface and at no time during operation shall have a face area less than 5 nor more than 7 square inches. The spacing shall be such as to provide not less than 1½ tamping feet for each square foot of cylindrical surface. The sheepsfoot roller shall be weighted so that the total weight of the roller and ballast in pounds divided by the total areas of the maximum number of tamping feet in one row generally paralled to the axis of the roller shall provide for a range of 250 to 400 pounds per square inch by varying the roller ballast.

(f) Tests for Compaction. Samples for testing of all materials in the embankments, both before and after placement and compaction, will be taken by the contracting officer at frequent intervals. Corrections, adjustments, and modifications of methods may be required as the result of these tests, for materials, moisture content, or additional compaction of the materials, in the embankment. In taking samples for control and record purposes, the contractor shall supply labor required to assist the inspector, as directed by the contracting officer. During the construction of the embankments, it may be necessary for the contractor as directed by the contracting officer to construct test embankments which will form part of the completed fill to determine the number of passes or moisture content necessary to obtain the desired compaction.

(g) Additional Compaction. - If the tests specified above indicate that the desired compaction of the materials in the Class I and Class II compacted earth fills is not secured by the compaction specified in paragraph 3-04 (d), additional compaction may be required by the contracting officer. Additional compaction shall consist of making not less than 2 passes of a sheepsfoot roller specified in paragraph 3-04 (e) over such designated areas. Each 2 passes of the roller shall overlap the adjacent rolled area by at least 2 feet. This procedure will be repeated as often as is necessary to obtain the desired compaction.

(h) Measurement and Payment.

(1) Measurement of Class I and Class II compacted earth fills placed in the embankments, will be made between the lines indicated on the drawings and the required stripping or excavation lines. If settlement gates are installed by the contractor measurement of settlement will be made between the foundation line after stripping or excavation and a survey of settlement plates at time of acceptance, (see par. 3-10). Payment for Class I and Class II compacted earth fill will be made at the applicable contract unit price per cubic yard for "Earth Fill Compacted Class I" and Earth Fill Compacted Class II", which payment shall include all incidental work specified or required such as transporting and spreading, mixing, scarifying, harrowing, moistening, drying, compacting, removing oversize stones, objectionable materials, furnishing laborers for sampling

and constructing test embankments. Any payment for fill due to foundation settlement, will be included in the final payment for embankment.

(2) Payment for each additional two passes of a roller as required by the contracting officer will be made at the contract unit price per square (100 sq. ft. ) for "Rolling for Each Additional Two Trips".

### 3-05. FILTER

(a) General. - Filters shall be constructed in 12 inch layers at the locations and to the lines and grades shown on the drawings, or at such other locations as may be required by the contracting officer. Each 12 inch layer shall be compacted by covering the entire area with one pass of tractor tread. The material shall conform to the requirements specified in the following paragraph and, if practicable during construction, shall be kept to the same height as the adjacent fill material. Any material encountered in the required excavation that meets the requirements of paragraph 3-05 (b) may be used for the filter. Additional materials required for the filter not obtainable from required excavation shall be obtained from other sources by the contractor.

(b) Filter Material. - The material for filters shall be well graded sand, or sand and gravel, which after placement, shall contain at least 40 percent by weight which will pass the ¼-inch mesh screen and no stones shall be larger than 6 inches. Of the material passing the ¼-inch screen, at least 80 percent by weight shall pass a No. 10 mesh screen, and not more than 10 percent shall pass the No. 200 mesh screen. Samples of the material the contractor proposes to use shall be submitted to the contracting officer at least 30 days prior to the date that the contractor plans to commence placement of filter.

(c) Filter material for the 2½ foot depth of selected gravel or crushed rock surrounding the drain pipe behind lock walls will be concrete aggregate ( size 3/16 to 3/4 inch) furnished by the Government.

(d) Measurement and Payment. - Measurement of filter material will be made between the lines indicated on the drawings, or as modified by the contracting officer. Payment for furnishing and placing filter material, regardless of source will be made at the contract unit price per cubic yard for "Filter."

### 3-06. SAND AND GRAVEL BACKING. -

(a) General - Sand and gravel backing for riprap on slopes and for drains behind lockwalls shall be constructed to the lines and grades shown on the drawings. During construction the placing shall be kept at substantially the same level as the compacted earth fill. Any material encountered in the required excavation that meets the requirements of this paragraph may be used for sand and gravel backing. Additional materials required for the sand and gravel backing not obtainable from required excavation shall be obtained from other sources by the contractor.

(b) Material. - Material for sand and gravel backing shall consist of bank run sand and gravel of which the material after placement shall contain from 30 to 60 percent by weight retained on the ¼-inch mesh screen, and no stones shall be larger than 6 inches. Of the material passing the ¼-inch mesh screen, not more than 20 percent shall pass the No. 200 mesh screen. Samples of proposed material shall be submitted as stated in paragraph 3-05 (b).

(c) Measurement and Payment. - Measurement of sand and gravel backing material will be made between the lines indicatd on the drawings, or as modified by the contracting officer. Payment for furnishing and installing backing material, regardless of source, will be made at the contract unit price per cubic yard for "Sand and Gravel Backing.

3-07. RIPRAP.

(a) Classification. - All rock for the riprap protection of the enbankments shall be sound, durable rock, other than shale, and as approved by the contracting officer, obtained from the required excavation. Riprap shall be composed of the following two classes of material;

(1) Class A. - The riprap shall be clean and rough, and the least dimension of any stone shall be not less than one-third its greatest dimension. Eighty percent of the rock must weigh over 500 pounds and shall graduate with fair uniformity to a minumum weight of 200 pounds.

(2) Class B. - The riprap shall consist of clean stones and boulders removed from the compacted earth fill material and rock other than shale obtained from the required excavations. This riprap shall consist of rocks weighing in general not over 250 pounds, of which not more than 10 percent of the whole shall be formed of pieces weighing less than 15 pounds which shall be well distributed throughout the mass.

(b) Placement. - Riprap shall be dumped in the sections to the line and grades shown on the drawings or as directed by the contracting officer. The different sizes of each class shall be well distributed within the section. Care shall be taken in dumping and placing not to disturb the underlying fill. The riprap forming the slope of the dikes shall be placed in approximately horizonatal layers not exceeding 3 feet in thickness as the compacted earth fill progresses, and shall be kept substantially the same level as the compacted earth fill. Any change in the slopes of the compacted earth fill including slides and washout will be repaired by the contractor as directed by the contracting officer at no cost to the Government; and, at the end of a working season for placing compacted earth fill, the dump riprap sections will be complete. In the areas where Class B dumped riprap will form the final surface, such hand placing of the finished rock surface will be required as will insure a reasonably smooth and continuous surface to the lines shown on the drawings or as modified by the contracting officer with a tolerance not exceeding 9 inches.

(c) Measurement and Payment. - Measurement for riprap in the dumped riprap sections will be made in the embankments only between slope lines and grade lines shown on the drawings or as modified by the contracting officer for the two classes of riprap and payment will be at the applicable contract unit prices per cubic yard for "Riprap, Dumped; Class A", and "Riprap, Dumped; Class B", which will include payment for the selection of the materials, placing, and all other work required for the completion of the riprap sections in accordance with these specifications.

3-08. SEEDING.-

(a) Preparation of Seed Bed. -

(1) The areas indicated on the drawings or required by the contracting officer shall be seeded. All areas to be seeded, prior to

fertilizing and seeding, shall be harrowed or raked until the soil has become loosened and pulverized. All sticks, litter, roots, weeds, stones larger than 1 inch in diameter and other objectionable materials shall be removed to a depth of 2 inches. The surface of all seeded areas shall be trimmed and raked to conform to finished grades, after which the soil shall be fertilized as specified below. Immediately before sowing the seed, the surface of the seed bed shall be sprinkled, if necessary, and raked to a depth of 3/4 of an inch. The raking shall be done in a direction parallel to the contour lines of the slopes (not uphill or downhill).

(2) Method of Fertilizing. - Prior to seeding, fertilizers shall be uniformily spread in a manner satisfactory to the contracting officer. The seed beds shall be fertilized with 1,000 pounds of 20% superphosphate, and 200 pounds of sulfate of ammonia to the acre. In place of superphosphate, 330 pounds of TVA. metaphosphate to the acre may be used.

(b) Seeding. - The quantity and types of seeds specified below shall be sown on prepared seed beds in a manner satisfactory to the contracting officer. The mixtures shall be sown at the earliest date possible between May 1 and September 1. The seed mixtures shall be sown by a mechanical hand seeder or drill. Whenever practical, the mixtures shall be sown in two applications, one-half the seed while the sower is travelling in one direction, and the other half sown while travelling at right angles to the first. The oats or rye shall be sown separately and prior to the remainder of the seed mixture. If oats or rye is sown, on the surface the seeds shall be covered by raking to a depth from 1 to 1½ inches. This will not be required if the oats or rye are sown with a drill. After all the seed is sown, the seed bed shall be lightly raked with iron rakes, and then rolled with a lawn roller in a manner satisfactory to the contracting officer.

(1) Seed Mixture. - The seed mixtures shall consist of the seeds specified in the table below. When directed by the contracting officer, the seed mixtures may be varied to suit special conditions of soil peculiar to the areas to be seeded. The seed furnished shall be of the previous year's crop and in no case shall the weed content exceed 1% by weight.

Seed Mixture for Seed Bed not Containing topsoil

| Kind of seed | %Purity | %Germination | Amount lbs per acre |
|---|---|---|---|
| Sweet Clover | 99 | 85 | 5 |
| Alfalfa | 98 | 85 | 2 |
| Black Medic | 95 | 80 | 1 |
| Orchard Grass | 97 | 90 | 3 |
| Timothy | 98 | 85 | 3 |
| Redtop | 98 | 90 | 4 |
| Ladine Clover | 97 | 90 | 1 |
| | | | 19 |
| Oats (Seeding prior to July 15)or | 99 | 90 | 30 |
| Rye (Seeding after July 15) | 99 | 90 | 35 |

(2) Inoculation. - The alfalfa, black medic, sweet clover, and ladine clover seeds shall be inoculated with pure cultures of nitrogen

fixing bacteria. Inoculants shall consist of pure bred soil or sand cultures, not more than one year old, and shall meet the approval of the New York State Department of Agriculture and Markets. The inoculants shall be mixed with the seed according to the vendor's instructions. After the mixture is dried, it shall be mixed with the grass seeds. All mixing, drying and storing shall be done in the shade. The seed mixtures shall be applied to the seed bed within 72 hours after the legume seeds are inoculated.

(c) Maintenance and Reseeding. - The contractor shall maintain the areas sown with the above seed mixture until all work on the contract has been completed and accepted by the contracting officer. The maintenance shall consist of refilling rain washed gullies, reseeding, mowing, watering during periods of drought, and other similar operations when required by the contracting officer. The contractor may, if he desires, protect slopes against erosion until seeding becomes established by spreading on the surface about four tons of straw to the acre.

(d) Measurement and Payment. - Measurement for seeding will be made by the acre for the area within the line shown on the drawings or as modified by the contracting officer. The contract unit price shall include payment for all work in connection with furnishing and sowing all necessary seed, raking and rolling the seeded areas, preparing the seed beds, furnishing and placing all necessary fertilizer, and maintaining all seeded areas. Payment for seeding all seed beds will be made at the contract unit price per acre for "Seeding."

## 3-09. PROTECTION OF SETTLEMENT GAGES, PIEZOMETERS, AND PRESSURE CELLS.

In order to enable measurements and observations to be made during and after construction of the work required under the contract, the Government may install with its own forces a number of devices in and on the dike fills consisting of settlement plates and gages, piezometers, and pressure cells. The contractor shall conduct his operations in such a manner that these devices and appurtenances will not be damaged. Fill around pipes and bars installed in and on the dike fills shall be placed and compacted by the contractor to the density of the surrounding compacted fill in the manner specified in paragraph 3-04 and herein. Separate payment will not be made for such protection and special measures required in connection with settlement gages, piezometers, and pressure cells and their appurtenances installed by the contracting officer.

3-10. DETERMINATION OF FOUNDATION SETTLEMENT. - If the contractor desires to install settlement gages for purposes of measurement of additional fill required by settlement he may do so at his own expense. The location settlement and details of gages installed by the contractor shall as approved by the contracting officer, and the record settlement indicated by the gages will be kept by the contracting officer. The settlement as determined by the gages will be used to compute the settlement of the foundation surface. The elevation of the foundation surface at the time of acceptance of the work will be used to measure the quantity of embankment fill placed by the contractor except in those areas where gages are damaged or lost due to the fault of the contractor. No measurement of or payment for fill due to settlement will be made except in areas where the contractor provides approved settlement gages.

## SECTION IV

## TIMBERWORK

4-01. TIMBER AND LUMBER. -

(a) General. - All timber and lumber shall be straight, even-sawed, sound, and entirely free from all defects which might impair its durability or its usefulness for the purpose intended.

(b) Softwood shall conform to Federal Specifications MM-L-751 for "Lumber and Timber; Softwood," yard lumber, grades as specified or required.

(1) Common Timber for stop logs, seal and bearing blocks shall be pine, Douglas Fir, hemlock, or other approved species, "Numbers 1 or 2 Common Timbers," grade and shall be treated in accordance with Federal Specification TT-W-571a for "Wood-Preservative; Preservative-Treatment."

(c) Hardwood shall conform to Federal Specification MM-L-736 for "Lumber and Timber; Hardwood," yard lumber, grade as specified or required.

(1) White Oak, unless otherwise specified, shall conform to the latest specifications of the National Hardwood Lumber Association for "Common Dimension" timber, except that it shall have full, sound square edges when in place. It shall be of commercial sizes, surfaced on four sides.

(d) Framing. - All timber shall be accurately framed and fitted and securely bolted. Holes for bolts shall be 1/16 inch less diameter than body of the bolt to be used. Care shall be taken in framing to work out permissible defects wherever possible.

(e) Painting. - Except where other types of painting or creosoting are specified; the surfaces of all timbers intended for permanent incorporation in the work shall be painted with 1 coat of primer (see par. 6-06 (c)) immediately upon delivery on the work, and stored and suitably protected to prevent excessive checking. After fabrication and fitting, all surfaces of timbers shall be painted 2 coats finish paint, (see par. 6-06 (d)). All paint and painting shall conform to the requirements of Section XVI.

(f) Measurement and Payment. - Unless otherwise specified, all timber will be graded in accordance with standard commercial grading rules and on the basis of the dimensions indicated on the drawings. The contract price will include nails and spikes less than 3/8 inch in diameter, and all carpenter work. Payment for all timber, unless specified to be paid for otherwise, will be made at the contract price per 1,000 feet, board measure (M.F.B.M.) for "Timber; White Oak," and "Timber; Stop Log, (Creosoted)," in place in the work.

## SECTION V - CONCRETE
## COMPOSITION, CLASSIFICATION AND STRENGTH

5-01. COMPOSITION. - Concrete shall be composed of cement, fine aggregate, coarse aggregate and water so proportioned and mixed as to produce a durable plastic, workable mixture in accordance with all requirements under this section and suitable to the specific conditions of placement.

5-02. CLASSIFICATION.

(a) Designation. - Except where required to meet special conditions, all concrete shall be Class "A" or Class "B", in accordance with the conditions of application and the proportions of materials and strengths required.

(b) Class "A" concrete shall be used generally in thin walls, slabs, and beams, for embedding metal in pre-formed recesses, and at such other places as shown on the drawings or as directed by the contracting officer.

(c) Class "B" concrete shall be used for the mass masonry of lock walls, sills, and approach walls, and for all other structures unless otherwise noted.

5-03. STRENGTH.

Test specimens of concrete will be 6"x12" or 8"x16" cylinders. Samples will be wet-screened to remove aggregate greater than one-fourth the diameter of the test specimen. The mixes will be designed to secure concrete having at least the following compressive strengths at the age of 28 days:

| Class | Average for any 25 Consecutive cylinders | Minimum for any one cylinder |
|---|---|---|
| A | 3400 lbs. per sq. in. | 2600 lbs. per sq. in. |
| B | 3000 lbs. per sq. in. | 2200 lbs. per sq. in. |

5-04. HIGH-EARLY-STRENGTH-CONCRETE. - High-early-strength-concrete made with high-early-strength Portland cement or other special cements shall be used only when specifically authorized by the contracting officer. The 7-day compressive strength of concrete of any class, when made with high-early-strength cement, will be at least equal to the specified minimum 28-day compressive strength for that class using standard cement. All provisions of these specifications, except for cement and aggregates, shall be applicable to such concrete.

5-05. CEMENT AND AGGREGATES. - Cement will be furnished to the contractor by the Government in accordance with paragraph 1-10 of these specifications. Fine and coarse aggregates shall be furnished by the contractor. Sufficient rock may be obtained from the required excavation for the manufacture of crushed stone sand for fine aggregate and for crushed stone for coarse aggregate.

5-06. FINE AGGREGATE.

(a) Composition. Fine aggregate shall be natural sand or manufactured sand. If crushed stone sand is furnished for the fine aggregate it shall be manufactured from material which has been crushed to pass the 3" square mesh screen and be retained on a 1/2" square mesh screen. Tailings from this preliminary crushing and screening will not be accepted. Only clean, dense, tough, durable dolomite stone will be acceptable for artificial sand manufacture.

(b) Quality. - Fine aggregate shall consist of hard, strong, durable and uncoated particles.

(c) Grading.

(1) The fine aggregate shall be well graded from coarse to fine and when tested by means of U. S. Standard square mesh sieves shall fall within the following limits of gradation:

| Sieve Size | Percent Passing, by Weight | |
|---|---|---|
| | Natural Sand | Manufactured Sand |
| 3/8" | 100 | 100 |
| No.4 | 95 - 100 | 95 - 100 |
| 8 | 75 - 90 | 80 - 95 |
| 16 | 50 - 75 | 55 - 80 |
| 30 | 30 - 55 | 30 - 60 |
| 50 | 12½- 25 | 15 - 30 |
| 100 | 3.5- 8 | 5 - 12 |

(2) If natural sand is furnished the fineness modulus shall be not less than 2.50 nor more than 3.00; if manufactured sand is furnished the fineness modulus shall be not less than 2.40 nor more than 2.90; and in either case the fineness modulus of the sand shall not vary more than 0.20 from lowest to highest.

(3) Deficiencies in the quantities passing the #50 and #100 sieves may be compensated for by furnishing, through separate shipment and at the contractors expense, a sufficient quantity of fine dune sand of approved quality and grading. This quantity shall not exceed 15 percent by weight of the total fine aggregate.

(d) Deleterious Substances - The substances designated shall not be present in excess of the following amounts.

| | Percent by Weight |
|---|---|
| Clay lumps - - - - - - - - - - - - - - - - - | 1 |
| Material removed by decantation from agregates not more than - - - - - - - | 3 |
| Shale - - - - - - - - - - - - - - - - - - - - | 1 |

(e) Mortar Strength. Mortar specimens made with the fine aggregate shall have a compressive strength at 28 days of at least 90 percent of the strength of similar specimens made with Ottawa sand having a fineness modulus of 2.40$\pm$0.10 and the same cement.

(f) Tests. Fine aggregates will be subjected to the following tests:

(1) Freezing and thawing test performed in accordance with A.S.T.M. Specifications C137-39T, "Soundness of Aggregates by Freezing and Thawing," shall not show a loss in 25 cycles of more than 5 percent, or not more than that shown by sand of proven quality.

(2) Magnesium sulphate accelerated soundness test performed in accordance with A.S.T.M. Specification C88-39T, "Soundness of Aggregates by use of Sodium Sulphate or Magnesuim Sulphate," shall not show a loss in 10 cycles of more than 10 percent.

## 5-07. COARSE AGGREGATE.

(a) Composition. - Coarse aggregate shall be washed gravel or crushed stone.

(b) Quality. - Coarse aggregate shall consist of hard, tough, and durable particles free from adherent coating. It shall contain no vegetable matter nor soft, friable, thin or elongated particles in quantities considered deleterious by the contracting officer. Aggregate which has disintegrated or weathered badly under exposure conditions similarto those which will be encountered by the work under consideration, shall not be used. The substances designated below shall not be present in excess of the following amounts:

Soft particles (including shale)- - - -5%
Clay lumps - - - - - - - - - - - - - - - - 0.25%
Removed by decantation - - - - - - - - 1%
Thin or elongated particles- - - - - - 10%

When the material removed by decantation consists essentially of crusher dirt the maximum amount permitted may be raised to 1-1/2 percent. When crushed stone is used the crusher shall be equipped with a screening system which will entirely separate the dust from the stone and convey it to a separate bin.

(c) Size and Gradation.

(1) Coarse aggregate shall be generally rounded or cubical in shape and well graded from fine to coarse within each designated size range so that concrete of the required workability, density, and strength can be made without the use of an excess amount of sand, water, or cement.

For Class "A" concrete the maximum size aggregate shall be not more than 1-1/2 inches.

For Class "B" concrete the maximum size aggregate shall be not more than 3 inches.

Coarse aggregate shall be separated, and the specified sizes delivered separately in accordance with the following:

3/16" to 3/4"
3/4" to 1-1/2"
1-1/2" to 3"

Within any of the above-indicated size limits, not less than 85% of the material shall be retained oh a standard square mesh screen of the minimum size aggregate indicated, and not more than 5 percent shall be retained on a standard square mesh screen of the maximum size aggregate indicated, and 100 percent shall pass a mesh screen 1-1/2 times the maximum size aggregate indicated.

(2) The grading of the combined coarse aggregate, in the mixed concrete, shall fall within the following limits:

| | (Percent by Weight)<br>Passing |
|---|---|
| Maximum size mesh screen (square mesh) | 97 - 100 |
| 1/2 maximum size mesh screen (square mesh) | 40 - 70 |
| No. 4 sieve | 0 - 6 |

(d) Tests. - Coarse aggregates will be tested and shall be subjected to the following:

(1) Freezing and thawing test performed in accordance with A.S.T.M. Specification C137-39T, "Soundness of Aggregates by Freezing and Thawing," shall not show a loss in 25 cycles of more than 5 percent.

(2) Magnesium sulphate accelerated soundness test performed in accordance with A.S.T.M. Specification C88-39T, "Soundness of Aggregates by use of Sodium Sulphate or Magnesium Sulphate," shall not show a loss in 10 cycles of more than 10 percent.

However, aggregate failing to pass these tests may be used, with the approval of the contracting officer, provided it has given satisfactory services for a period of not less than 5 years under exposure conditions similar to those to which it will be subjected in the proposed work.

5-08. WATER. - The water used in mixing concrete shall be fresh, clean and free from injurious amounts of oil, acid, alkali or organic matter.

### 5-09. STORAGE.

(a) Cement.

(1) Immediately upon receipt, at the site of the work, cement shall be stored in a thoroughly dry, weathertight, and properly ventilated building or bin with adequate provisions for the prevention of the absorption of moisture. Storage shall be such as to permit easy access for inspection and definite identification of each shipment.

(b) Aggregates. - The fine and coarse aggregates shall be stored separately, and in such manner as to avoid the inclusion of any foreign material in the concrete. Stock piles of coarse aggregates shall be built in horizontal layers to avoid segregation.

### 5-10. PROPORTIONING.

(a) Basis. - All concrete materials will be proportioned so as to produce a workable mixture in which the water content will not exceed the maximum specified.

(b) Control. - The exact proportions of all materials entering into the concrete shall be as directed by the contracting officer. The contractor shall provide all equipment necessary to determine, record, and control positively the actual amounts of the various materials, including water, cement, fine aggregate, and each individual size of coarse aggregate, entering into the concrete. The proportions will be changed whenever, in the opinion of the contracting officer, such change becomes necessary to obtain uniformity and workability or the specified strength, and the contractor will not be compensated because of such changes.

(c) Measurement. - All materials shall be measured by weight, One bag of cement will be considered 94 pounds in weight and 1 gallon of water as 8.33 pounds.

(d) Cement Content. - The cement content for each cubic yard of concrete shall generall fall within the following ranges:

Class "A" 5.0 to 6.0 bags
Class "B" 4.0 to 5.0 bags

For concrete deposited in water, the minimum cement content shall be 6.5 bags or 611 pounds to each cubic yard of concrete placed. The cement content shall be at all times subject to variation as deemed necessary by the contracting officer to attain the desired results.

(e) Water Content and Consistency of Concrete.

(1) In calculating the total water content in any mix, the amount of moisture carried on the surfaces of the aggregate particles shall be included. The total water content per bag of cement for each batch of concrete shall not exceed the following:

Class "A" 5.5 gallons or 45.8 pounds
Class "B" 6.5 gallons or 54.1 pounds

In all cases, however, the amount of water to be used shall be the minimum amount necessary to produce a plastic mixture of the strength specified and of the desired density, uniformity and workability. In general, the consistency of any mix shall be that required for the specific conditions and methods of placement, and ordinarily the slump shall be between 1/2 inch and 2 inches for Class "B" concrete, and between 1½ inches and 3 inches for Class "A" concrete when tested in accordance with the current specifications for "Method of Test for Consistency of Portland Cement Concrete," of the American Society for Testing Materials.

(f) Aggregate Content. - The total volume of aggregates to be used in each cubic yard of concrete shall be that necessary to produce a dense mixture of the required workability as determined by the contracting officer. The individual mixes will be based upon securing concrete having suitable workability, density, impermeability, and the required strength, without the use of an excessive amount of cement.

(1) Coarse Aggregate.

For Class "A" concrete the maximum size aggregate shall be not more than 1½ inches.

For Class "B" concrete the maximum size aggregate shall be not more than 3 inches.

Specified sizes shall be delivered separately to individual proportioning hoppers in accordance with the following:

a. 3/16" to 3/4"

b. 3/4" to 1½"

c. 1½" to 3"

(2) Fine Aggregate. - The fine aggregate will consist of natural sand or crushed stone sand and in either case will be furnished in one size graded so that at least ninety-five percent will pass a No. 4 square mesh sieve.

5-11. MIXING AND PLACING.

(a) Equipment. - The contractor shall provide at the site of the work a modern and dependable batch-type mixing plant with a minimum capacity of 600 cubic yards of concrete per 8 hours. The plant shall include not fewer than 2 complete mixers of equal capacity with separate power plants. The equipment shall provide adequate facilities for the accurate measurement, record, and control of each of the materials entering the concrete. The complete plant assembly, including provision to facilitate the inspection of operations at all times and the adequacy and dependability of each of its parts, shall be subject to the approval of the contracting officer, and shall conform to the following requirements.

It shall be capable of ready adjustment for compensating for the varying moisture content of the aggregates and for changing the proportionate batch weights.

It shall be capable of controlling the delivery of each material to within 1 percent by weight of the designated amounts.

It shall be arranged to permit the convenient removal of material in excess of the specified tolerances, and acceptable facilities shall be provided for readily obtaining representative samples from the batches for test purposes.

Each weighing unit shall include a visible springless gage which will register the scale load at any stage of the weighing operation from zero to full capacity.

Insofar as practicable, each dial and water-measuring device shall be in full view of the operator and the weighing equipment shall be arranged so that the operator may conveniently observe the operation of the bin gates and also the materials discharged into the mixer hopper.

The accuracy of the weighing equipment shall conform to the requirements of the U. S. Bureau of Standards. The contractor shall provide standard test weights and any other auxiliary equipment required for checking the operating performance of each scale or other measuring device and shall make periodic tests, in the presence of a Government inspector, in such a manner and at such intervals as may be directed by the contracting officer; provided, that unless otherwise directed by the contracting officer, such check tests of equipment in operation shall be made at least once every two weeks. After completion of such check tests the contractor shall make such adjustments, repairs, or replacements as the contracting officer may consider necessary to secure satisfactory performance.

The plant shall include a device for accurately measuring and indicating the quantity of water entering the concrete and the operating mechanisms must be such that leakage will not occur when the valves are closed. The filling and discharge valves for the water tank shall be so interlocked that the discharge valve cannot be opened before the filling valve is fully closed.

It shall include a device for accurately and automatically measuring and indicating the time of mixing, which shall be interlocked to prevent the discharge of concrete from the mixer before the expiration of the mixing period.

It shall include a device for recording and indicating the number of batches handled.

Each set of units for measuring cement and mixing water delivered to one or more mixers shall be provided with an accurate combined autographic recorder for making a continuous visible record on a single chart of measurement of all materials introduced into each batch, and of the consistency of the concrete during the mixing process. The recorder shall be housed completely, shall be capable of being locked, and shall be placed in a position convenient for use by the plant operator. The recorder paper furnished shall be ruled and printed so that each graph will be identified permanently and so that quantities and time may be read without scaling or calculating. Suitable means shall be provided to insure proper alignment, rate of travel, and tautness of the paper without wrinkling. The recording equipment shall include facilities for automatically registering on the chart for time of day at intervals of not more than 15 minutes and shall be designed for simplicity in operation and maintenance.

Each mixer shall be equipped with an efficient recording consistency meter or provided with equally suitable equipment or means satisfactory to the contracting officer for indicating concrete consistency and recording it on the combined autographic recorder chart. The sensitivity and range of the consistency meters shall be such that the effect of a change in slump of one inch shall be readily discernible to the operator, as determined by the contracting officer. The contractor shall furnish satisfactory evidence that the consistency meters which he proposes to use are adapted to the type of drum and loading of the mixers with which they are to be used. If the mixers are provided with consistency meters operating on the principle of measuring electrical input to the mixer motors, adequate means shall be provided for eliminating errors due to operating the motor from a variable voltage supply source, with resultant changes in motor input which are not caused by changes in concrete consistency. If the contractor proposes to use means for the partial elimination and compensation of these errors, such means shall be subject to the approval of the contracting officer and the residual errors shall not exceed one percent of the values being measured. Errors in registration of concrete consistency caused by variable friction in the mixer equipment shall be eliminated or minimized by providing adequate antifriction bearings and lubrication or by other means satisfactory to the contracting officer. All graphic charts recorded in accordance with this paragraph shall become the property of the Government.

(b) Time. The minimum time for mixing each batch, after all materials are in the mixer, shall be as follows:

| | | |
|---|---|---|
| 1/2-cubic yard mixer, or smaller | 1-1/4 | minutes |
| 3/4 - to 1½cubic yard mixer | 1½ | minutes |
| 1½ - to 3-cubic yard mixer | 2 | minutes |
| larger than 3-cubic yard | 2½ | minutes |

The mixer shall revolve at a uniform speed, a minimum of 12 revolutions per minute after all materials have been placed in it. Neither speed nor volume capacity of the mixer shall exceed those recommended by the manufacturer. Excessive over-mixing, requiring additions of water to preserve the required consistency, will not be permitted. Should any mixer at any time produce unsatisfactory results its use shall be promptly discontinued until it is repaired or replaced.

(c) Conveying. - Concrete shall be conveyed from mixer to forms as rapidly as practicable, by methods which will prevent segregation or loss of ingredients. It shall be deposited as nearly as practicable in its final position. Chutes used shall be such that the concrete slides in them and does not flow. Chutes with a flatter slope than 1 or 2 will not be permitted. There shall be no free verticaldrop greater than 5 feet except there specifically authorized by the contracting officer.

Methods of conveying concrete to any part of the structure by which the concrete is loaded into chutes, belt conveyors, or other similar equipment and carried in a thin, continuously exposed flow, to the forms, will not be permitted except for very limited or isolated sections of the work, and then only when approved in writing by the contracting officer.

Placing of concrete in the lock shall, in general, be done by means of bottom-dump buckets of sufficient size to handle the full capacity of one mixer. The design of the buckets shall be subject to the approval of the contracting officer, and shall be such as to permit close regulation of the amount of concrete to be deposited in each during position. It is contemplated that the full capacity of a bucket may be deposited in one operation where this has no objectionable effect on the placement of concrete, but near forms and around embedded items or elsewhere as directed by the contracting officer, the discharge shall be controlled so that the concrete may be effectively compacted into layers not exceeding 18 inches in thickness with a minimum of lateral movement and accompanying tendency for segregation and the formation of rock pockets.

(d) Placing.

(1) Concrete shall be placed before initial set has occurred, unless otherwise authorized by the contracting officer, before it has contained its water content for more than 30 minutes.

(2) Concrete when deposited in the forms shall have a temperature of not more than 75 degrees F. and not less than 40 degrees F. However, when the temperatures of the materials are such that the temperature of the fresh mixed concrete is 55 degrees or more, the mixing water shall be cooled to a temperature of 35 degrees F., and only aggregates taken from the coolest portions of the stockpiles shall be used. Any heating, cooling, refrigerating, or other operations necessary in order to produce a concrete having a temperature within the above specified temperature limits, shall be done by the contractor and the cost thereof shall be included in the unit contract prices for the various classes of concrete.

(3) Unless otherwise specified, all concrete shall be placed in the dry upon clean, unfrozen, damp surfaces, free from running water, and never upon soft, mud, dry porous earth, or upon fills that have not been subjected to approved rolling or tamping until optimum compacting has been obtained.

(4) Rock surfaces upon which concrete is to be placed shall be approximately horizontal or stepped, and shall be clean, solid, and free from oil, running water, mud, objectionable coatings, debris and loose, semi-detached, or unsound fragments and shall be sufficiently rough to assure satisfactory bond with the concrete. Immediately before concrete is placed, all such rock surfaces shall be cleaned thoroughly by the use of high velocity air-water jets, wet sandblasting, stiff brooms, picks, or other effective means satisfactory to the contracting officer. All pools of water shall be removed from depressions in order to insure proper bonding of the fresh concrete to the rock surfaces and no inflow of water into the foundation will be permitted. All necessary installations of riser pipes, headers, sand drains, and other installations necessary to produce a foundation free of running or standing water shall be installed by the contractor and so welded or otherwise securely fastened in place as to prevent their being jarred loose by concrete placement. No separate payment will be made for such installations. No wooden plugs or other organic materials will be placed permanently in any foundation. All absorptive surfaces shall be throughly wetted for 48 hours and spread with a layer of mortar about 1/2 inch thick immediately before the concrete is placed. The mortar shall be of the same cement-sand ratio as used in the concrete.

(5) The layout of all monoliths shall be as shown on the drawings or as directed or approved by the contracting officer before concreting is commenced.

(6) All concrete shall be deposited in approximately horizontal layers, unless otherwise specifically authorized or directed by the contracting officer, and the concreting shall be carried on as a continuous operation, as far as practicable, until the placing in the course, section, panel or monolith is completed. Concrete must be covered within 45 minutes to one hour, depending on cement used, with fresh concrete during one pour. Courses of mass concrete in the lock structures shall not exceed 5 feet in thickness for sections 35 feet or greater in width and shall not exceed 10 feet in thickness for sections less than 35 feet in width unless approved

by the contracting officer. In general minimum of 24 hours shall elapse for each foot of course thickness between the finishing of one such course and the starting of the next course, but in no case shall the elapsed period be less than 120 hours. The first two to four courses starting from the rock foundation and from lifts which have been in place longer than 15 days shall be limited to a maximum height of 2 to 3 feet; as determined by the contracting officer. Other courses shall generally have a minimum thickness of 4 feet, and maximum thickness of 12 feet.

(7) In dropping concrete through reinforcement, care shall be taken that no segregation of the coarse aggregate occurs. On flat surfaces where the congestion of steel near the forms makes placing difficult, a mortar of the same cement-sand ration as is used in the concrete shall be first deposited to cover the forms.

(8) All top surfaces not covered by forms and which are not to be covered by additional concrete or backfill shall be carried slightly above grade and struck off by board screed (see paragraph 6-11 (a).

(e) Vibrating. - Concrete shall be placed with the aid of mechanical vibrating equipment as approved by the contracting officer.

(1) Internal vibrators shall be used in all sections 10-inches or more in width or which are sufficiently large to accommodate them. External vibration shall be used when directed by the contracting officer as auxiliary to internal vibration.

(2) Vibrators shall be of sturdy construction, adequately powered and capable of transmitting to the concrete not less than 5,000 impulses per minute when operating under load (immersed in concrete). The frequency of vibration shall be subject to proof by measuring the impulses radiated by the vibrator, when operating in concrete designed for the project, by use of a Frahm vibrating-reed tachometer or equal. The vibration shall be sufficiently intense to cause the concrete to flow or settle readily into place and show a visible effect over a radius of at least 18 inches in the concrete.

(3) A sufficient number of vibrators shall be employed so that, at the required rate of placement, vibration throughout the entire volume of each layer of concrete and complete compaction are secured. At least one extra vibrator shall be constantly on hand at each point of placement (monolith) for emergency use.

(4) Form vibrators, where used, shall be attached to or held on the forms in such a manner as to transmit the vibration to the concrete effectively and shall be raised in lifts as filling of the forms proceeds, each lift being not more than the height of concrete visibly affected by the vibration. They shall now be placed horizontally at distances not greater apart than the radius through which the concrete is visibly affected.

(5) Internal vibrators shall be kept constantly moving in the concrete and shall be applied at points uniformly spaced not further apart than the radius over which the vibrator is visibly effective. The vibrator shall not be held in one location long enough to draw a pool of grout from the surrounding concrete. Internal vibrators shall be applied close enough to the forms to vibrate the surface concrete effectively but care shall be taken to avoid hitting the forms sufficiently to damage them.

(6) The vibration shall be such that the concrete becomes uniformly plastic and there shall be at least 10 seconds of vibration per square foot of surface of each layer of concrete, computed on the basis of the visibly affected radius, and taking over-lapping into consideration.

(7) Vibration shall be supplemented by forking and spading by hand adjacent to the forms on exposed faces. The concrete shall be compacted and worked in an approved manner into all corners and angles of the

forms and around reinforcement and embedded fixtures.

(f) Construction Joints. - Vertical joints shall be formed with tongue-and-groove keys at such locations and of such shapes and dimensions as approved or directed by the contracting officer. Horizontal joints shall be continuous throughout all monoliths to produce continuous horizontal lines on the faces of the lock walls. The horizontal edges of each completed pour not required to be chamfered that are exposed to weathering shall be struck off level for a distance of about 6 inches back from the form to provide an even and neat appearance between construction joints. Where required, dowel rods shall be used. All concrete in vertical members shall have been in place not less than 12 hours, and longer if so directed by the contracting officer, before concrete in horizontal members resting thereon is placed. After the top surface of a course is finally compacted, it shall be thoroughly protected from pedestrian traffic, materials being placed thereon, running water, or any activity upon the surface that might in any manner affect the initial setting of the concrete for a period of 4 to 20 hours as determined by the contracting officer. After the time required for initial set, the surface shall be washed with a high pressure air (air pressure capacity not less than 100p.s.i.) and water jet to remove all laitance and to expose clean sound aggregate.

Immediately before placing is resumed in each succeeding course, all approximately horizontal construction joint surfaces shall be washed with a high pressure air and water jet and scrubbed with steel brushes and brooms. Sand shall be added to the air-water jet when required to remove algae, stains and other substances injurious to bonding. After final cleaning and immediately before placing is resumed the surface shall be wetted and spread with a layer of mortar 1/2 inch thick. The mortar shall be of the same cement-sand ratios as the concrete.

Where fresh concrete is to be placed against smooth surfaces of previously placed concrete, the surface of the previously placed concrete shall be roughened by picking, or other means approved by the contracting officer, in order to secure adequate bond. No payment will be made for such roughening but the cost shall be included in the contract unit price for the class of concrete affected.

(g) In water. - When specifically authorized, concrete may be deposited in water having a temperature above 35 degrees F. The methods and equipment used shall be subject to the approval of the contracting officer. When deposited by the tremie method, the tremie shall be water-tight and sufficiently large to permit a free flow of concrete. The discharge shall be kept continuously submerged in the concrete and the shaft kept full of concrete to a point well above the water surface. When the bottom-dump bucket method is used, the bucket shall not be dumped until after it has come to rest on the surface upon which the concrete is to be deposited. The bucket shall be provided with a suitable cover, and the bottom doors, when tripped, shall open freely. The bucket shall be completely filled and slowly lowered in order to avoid backwash, and when tripped, it shall be slowly withdrawn until entirely free of the concrete. With either method, concreting shall proceed without interruption until the tip of the concrete is well above the water surface.

(h) Cold Weather. - Concrete shall not be placed when the ambient atmospheric temperature is below 35 degrees F. nor when the concrete is likely to be subjected to freezing temperatures before final set has occured unless specifically authorized by the contracting officer in writing. When so authorized, the materials shall be heated in such a manner that they will be free of ice, slush, snow, frozen lumps, etc., before entering the mixer. The temperature of the concrete when deposited in the forms shall be within the limits specified in paragraph 5-11 (d) (2). All methods and equipment for heating shall be subject to the approval of the contracting officer.

(i) Hot Weather. - For concrete placed during the extremely warm summer months and otherwise, when directed by the contracting officer, the contractor shall take whatever measures are necessary in order to produce a concrete having a temperature below the maximum limit specified in paragraph 5-11 (d) (2). The methods and equipment used shall be subject to the approval of the contracting officer.

## 5-12. TEST SPECIMENS.

(a) Number. - Test specimens, to determine whether the compressive strength of the concrete is in accordance with that specified in paragraph 5-03, will be taken by the Government inspector. At least 1 set of 3 specimens will be made for every major placement and, in general, for every 500 cubic yards of concrete placed, but in any event, a sufficient number of specimens will be taken to give a comprehensive knowledge of the concrete in each section of the work.

(b) Method. All specimens will be taken from the concrete in accordance with the current specifications of the American Society for Testing Materials. The specimens will be tested by and at the expense of the United States, either in its laboratory or in that of a recognized commercial testing agency.

## 5-13. FINISHING.

(a) General. - Immediately after placement, the concrete shall be properly forked back along the faces of all forms by the use of concrete forks or spades and then re-vibrated unless otherwise specifically authorized or directed by the contracting officer. The surface of concrete finished against forms shall be smooth, dense, and free from rock pockets. Immediately upon the removal of forms, all unsightly ridges or lips shall be removed and undesirable local bulging on exposed surfaces shallbe remedied by tooling and rubbing to the satisfaction of the contracting officer allholes left by the removal of tie rods, and all similar voids unless otherwise directed by the contracting officer shall be neatly filled with cement mortar mixed in the same proportions as the original mix, provided that wherever practicable mortar which has been mixed and allowed to stand for one hour shall be used and placed as directed by the contracting officer. Defective concrete shall be repaired by cutting out the unsatisfactory material and placing new concrete which shall be formed with keys, dovetails, or anchors to attach it securely to the other work. This concrete shall be drier than the usual mixture and shall be thoroughly tamped into place. All finishing, tooling, rubbing and filling of the rod holes and all patching of exposed surfaces must be performed immediately after forms are removed and the succeeding course of concrete shall not be placed until the exposed surfaces of the preceding lifts have been finished to the satisfaction of the contracting officer. All surfaces of concrete, not coverd by forms, that are not to be covered by additional concrete or backfill, shall have a wood float finish without additional mortar, and shall be true to elevations as shown on the drawings. Care shall be taken to see that all excess water is removed before making this finish. Other surfaces shall be brought to the specified finished elevation and left true and regular as approved by the contracting officer. Where considered necessary by the contracting officer, or where indicated on the drawings, joints shall be carefully made with a jointing tool. Every precaution shall be taken by the contractor to protect finished surfaces from stains or abrasions. No fire shall be permitted in diredt contact with any concrete at any time. Concrete surfaces, or edges likely to be injured during the construction period, shall be properly protected by leaving the forms in place or by erecting covers satisfactory to the contracting officer.

(b) Floor Surfaces. - Unless otherwise specified, floors of all buildings, and other surfaces where indicated on the plans or required by the contracting officer, shall be finished with a 1-inch monolithic sand-cement mortar surface. All water, laitance and any foreign matter shall be removed from the surfaces. The topping mixtures shall be spread evenly over the base within 45 minutes after the base has been placed. The mortar shall be of 1 part cement and 3 parts approved clean sand. The cement and sand shall be throughly mixed dry and then sufficient water shall be used to produce a medium stiff mortar. After placing, the mortar shall be floated to a true regular surface with a wood float and steel-trowled to a smooth finish. Troweling shall be the minimum amount consistent with obtaining a smooth dense surface and shall not be done until the mortar has hardened sufficiently to prevent excess fine material from being worked to the surface.

## 5-14. CURING.

(a) General. - Before actual concrete placement begins, the contractor shall have on hand and ready to install all equipment needed for adequate curing and protection of the concrete.

(b) Warm Weather. - All concrete shall be adequately protected from injurious action by the sun. Fresh concrete shall be protected from heavy rains, flowing water, and mechanical injury. All concrete shall be kept wet for a period of not less than 14 days by covering with water, or with an approved water-saturated covering or by a system of perforated pipes or mechanical sprinklers, or any other approved method which will keep all surfaces continuously (not periodically) wet. Where wood forms are left in place for curing, they shall be kept wet at all times to prevent opening at the joints and drying out of the concrete. Water for curing shall conform to the requirements of paragraph 5-08, and shall be generally clean and entirely free from any elements which, in the opinion of the contracting officer might cause staining or discoloration of the concrete.

(c) Cold Weather. - Concrete when placed during cold weather shall be kept moist and provided with adequate protection, subject to the approval of the contracting officer, so that the air in contact with the concrete will be maintained at temperatures between 50 degrees F.and 70 degrees F. for at least the first 5 days. For massive section, where the atmospheric temperatures are sufficiently low, in the opinion of the contracting officer, to cause excessively rapid cooling and contracting of the exterior surfaces, the period for maintaining the temperature of the air in contact with the concrete between 50 and 70 degrees F. may be required to extend for 14 days. In extremely cold weather, the removal of temperature protection shall be done gradually so that the temperature at a rate not faster than 5 degrees F. in any one hour, or 50 degrees F. in any 24 hour period. Salt or other chemicals shall not be admitted into the mixture to prevent freezing.

5-15. FORMS.

(a) Materials. - Forms shall be of wood, steel or other approved material, except that the sheeting for all exposed surfaces shall be tongue-and-groove lumber of uniform width unless otherwise specifically authorized. Forms of like character shall be used for similarly exposed surfaces in order to produce a uniform appearance. The type, size, shape, quality and strength of all materials of which the forms are made and the design of the forms shall be subject to the approval of the contracting officer.

(b) Construction. - Forms shall be built true to line and grade, and shall be mortar-tight and sufficiently rigid to prevent displacement or sagging between supports. Where forms for continuous surfaces are placed in successive units, care shall be taken to fit the forms tightly over the completed surface so as to prevent leakage of mortar from the concrete and to maintain accurate alignment of the surface. Responsibility for their adequacy shall rest with the contractor. Their surfaces shall be smooth and free from irregularities, dents, sags, or holes when used for permanently exposed faces. Bolts, and rods used for internal ties shall be arranged so, that, when the forms are removed all metal will be not less than 2 inches from any concrete surface. Bolt holes shall be reamed with a suitable toothed reamer so as to leave the surface of the holes clean and rough and shall be filled with mortar as specified in paragraph 5-11 (a)., immediately upon removal of the forms. Wire ties will not be permitted without the approval of the contracting officer. and at no time where the concrete surface will be exposed to weathering and where discoloration will be objectionable. All forms shall be so constructed that they can be removed without hammering or prying against the concrete. Unless otherwise indicated, suitable moldings shall be placed to level or round exposed edges, at expansion joints and or any other points as my be required by the contracting officer.

(c) Coating. Forms, except those lined with absorptive form lining, shall be coated with a non-staining mineral oil which shall be applied shortly before the concrete is placed.

(d) Removal. - Forms shall not be removed without the approval of the contracting officer, and all removal will be accomplished in such manner as will prevent injury to the concrete. Forms shall not be removed before the expiration of the minimum number of days indicated below, except when specifically authorized by the contracting officer. When, in the opinion of the contracting officer, conditions on the work are such as to justify it, forms may be required to remain in place for longer periods.

| | |
|---|---|
| Arches, beams and slabs | 14 days |
| Columns | 7 days |
| Walls and vertical faces | 2 days |

(e) Absorptive Form Lining. - In addition to the requirements for work specified above, the forms for all permanently exposed surfaces, of lock walls and approach walls, not covered with backfill, and galleries and culverts through the lock shall be constructed of matched lumber, approved by the contracting officer, and line with absorptive lining. The absorptive form lining shall be capable through its absorptive capacity of eliminating voids, pits and other common defects from the surface of the concrete placed against it. The form lining shall be highly absorptive to air and water and shall possess surface characteristics such as will result in a dense concrete with a satisfactory surface texture, and the minimum amount of sticking of the lining upon removal of the forms. The lining shall be readily adaptable to cutting, fitting and any other operating necessary in connection with its use. The lining itself, and any coating or treatment employed in its manufacture, shall be such as will not create discoloration or interefere with the normal chemical reactions of the cement in the concrete. The type of lining shall be subject to the approval of the contracting officer. Tests shall be made by the contractor of all proposed absorptive lining as directed by the contracting officer. These tests shall include the use of absorptive form lining on concrete surfaces which will be later covered by backfill. Samples shall also be furnished to the Government for laboratory tests, before approval of any type of lining by the contracting officer. Horizontal joints will not be permitted in absorptive form lining for surfaces between the top and bottoms of concrete lifts. The locations and directions of joints in absorptive form lining shall be as directed or approved by the contracting officer. For cutting and trimming the absorptive lining, the contractor shall use tools which are well adapted for this work and are maintained in such condition that smooth edges will be produced. The joints between the sheets of absorptive form lining shall be fitted smoothly and accurately, and patching of the sheets of absorptive form lining will not be permitted. At joints the edges of the form lining shall be in contact but shall not be pressed tightly together. Absorptive form lining shallbe attached to the forms with only a sufficient number of any nails or other means to hold the lining snugly in contact with the surface of the forms, and free from bulges and other imperfections that might cause unevenness or roughness of the concrete surfaces. Nails shall be driven so far so that under side of the nailheads will be flush with the surface of the absorptive lining, and care shall be taken not to make dents in the surface of the lining with hammers or in any other manner. After the absorptive lining has been nailed in place, the joints shall be rubbed with a smooth tool to make the joints smooth and to press down any projecting fibers. In tightening the form anchors where absorptive form lining is in contact with the face of a previous life, sufficient pressure shall be applied to compress the lining at the surface of contact so as to compensate for the reduction in thickness of the lining not in the surface of contact so will be caused by the pressure of the freshly placed concrete. Inscfar as practicable, the contractor shall avoid splashing mortar or concreteon the absorptive lining and shall remove, without damage to the lining, such coatings as have set or become dry before the concrete is placed against the lining. Absorptive from lining or fibrous materials shall be used only once and after being used shall be removed from the site of the work or disposed of as approved by the contracting officer. Forms lined with absorptive lining shall, in general, be removed or loosed early enough to avoid difficulty from sticking; except, the form shall be allowed to remain in place for a sufficient length of time to produce adequate support for the concrete, as determined by the contracting officer. Fibers from the lining which adhere to the concrete when the forms are removed, shall be removed without damage to the concrete, by brushing or other suitable means, as approved by the contracting officer. At all times subsequent to delivery of the absorptive form lining and prior to the placing of concrete against the lining, the contractor shall take all precautions necessary to protect the lining from becoming damp or wet to such an extent as to damage the material or to reduce its effectiveness as an absorptive medium. Particular care shall be exercised to protect absorptive form lining during clean-up operations, and temporary protections of such lining will be required. The use of absorptive form lining which has become wet or which contains visible eternal defects such as holes, ragged or untrue edges breaks, cracks, tears, protuberances or indentations, will not be permitted.

### 5-16 PLACING STEEL REINFORCEMENT.

(a) General. - All reinforcing steel will be furnished to the contractor by the Government with freight paid to the point of delivery noted in paragraph 1-10. The contractor shall unload, transport and place all steel reinforcement, including rods, fabric and structural shapes as indicated on the drawings or otherwise required. The contract unit price for "Steel Erection; Concrete Reinforcing," shall include unloading, hauling to site, cleaning, proper storage and straightening, if necessary. All reinforcement shall be, when surrounding concrete is placed, entirely free from rust, scale, grease or other coating which might destroy or reduce its bond with the concrete. All placing shall be in accordance with drawings furnished or approved by the contracting officer.

(b) Cutting and Bending. - Steel reinforcement will be cut and bent to the required length and shapes at the mill. Miscellaneous bending that may be required at the site shall be in accordance with standard approved practice and by approved machine methods. Bar lists and bending schedules will be furnished by the Government.

(c) Quality. - The steel reinforcing will conform to the requirements of paragraph 6-07.

(d) Minimum Spacing of Rods. - The Spacing of rods shall be as indicated on detail drawings to be furnished by the Government later. The clear distance between parallel rods shall not be less than 1½ times the diamet of round rods, or twice the side dimensions of square rods, but in no case shall the clear spacing between the bars be less than 1½ times the maximum size of the coarse aggregate used in the concrete, unless specifically authorized by the contracting officer.

(e) Relation of Rods to Concrete Surfaces. - Except where otherwise indicated, reinforcement shall be placed as follows:

(1) All main reinforcement in massive concrete sections shall be placed not less than 4 inches from any concrete surface, unless otherwise specifically indicated or authorized.

(2) All main reinforcement in walls and slabs of buildings exposed to the weather and in fire-resistent construction, shall be placed not less than 1 inch from the surface in walls and slabs, 1½ inches in floor beams and 2 inches in girders and columns. In interior flat slab construction, the minimum cover may be reduced to 3/4 inch. For interior work where fire hazard does not exist, the main reinforcement shall be placed not less than 3/4 inch from the surface in walls and slabs, 1 (one) inch in floor beams, and 1½ inches in girders and columns.

(3) The covering of stirrups, spacer rods, and similar secondary reinforcement may be less than the above dimensions by the diameter of suc rods. The above dimensions shall be measured from the face of the reinforcemen to the face of the forms.

(f) Splicing. - Where splices in reinforcement, in addition to those indicated on drawings or directed by the contracting officer, are necessary, there shall be sufficient lap to transfer the stress by bond. Rods shall be lapped not less than 40 diameters and splices shall be staggered. The lapped ends of rods shall be separated sufficiently or connected properly to develop the full strength of the rods. Adjacent sheets of fabric reinforcement shall be spliced by lapping not less than 6 inches, the lapped ends being securely wired together. The expense caused by any laps other than those indicated on the drawings or directed to placed by the contracting officer, which are provided for the convenience of the contractor, shall be borne by the contractor.

(g) Supports. - All reinforcements shall be secured in place, true to the lines and grades indicated, by use of metal or concrete supports, spacers or ties as approved by the contracting officer. Such supports shall be of sufficient strength to maintain the reinforcement in place throughout the concreting operation, and shall be used in such a manner that they will not be exposed on the face of, nor in any way discolor not be noticeable in the surface of the finished concrete. The cost of furnishing and placing all supports, spacers, ties and/ or other devices required for reinforcement shall be included in the contract unit price for "Steel Erection: Concrete Reinforcing."

(h) Protection for Future Use. - Exposed reinforcement intended for bending with future work shall be protected from corrosion by heavy wrapping of burlap saturated with bituminous material.

## 5-17. EMBEDDED ITEMS.

(a) Before placing concrete, care shall be taken to determine that any embedded metal or wood parts are firmly and securely fastened in place as indicated. They shall be thoroughly clean and free from coating, rust, paint scale, oil, or any foreign matter. The embedding of wood in concrete shall be avoided whenever possible, metal being used instead. If wood is allowed, it shall be thoroughly wetted before the concrete is placed. Any air or water lines or other materials embedded in the structure as construction expedients shall conform to the above requirements and upon completion of their use shall be backfilled with concrete or grout as directed by the contracting officer. No payment will be made for such items nor for backfill of the items.

## 5-18. EXPANSION AND CONTRACTION JOINTS.

Expansion and contraction joints shall be constructed between concrete monoliths and at such other points with such dimensions as shown on the drawings or required by the contracting officer. The method and materials used shall be subject to the approval of the contracting officer and the materials shall conform to current Federal Specification wherever applicable. Unless otherwise indicated on the drawings, or required by the contracting officer, expansion and contracting joints shall be made by the use of special bituminous cement "Type B" as specified in paragraph 6-33, and light-weight roofing weighing 30 pounds per square. The joint shall be made by troweling a coat of bituminous cement on the entire concrete surface to be covered by roofing over a width of 18 inches adjacent to top surfaces and vertical surfaces, and such filler shall then be thoroughly covered with a trowel coat of bituminous cement. In no case shall corner protection angle or other fixed metal embedded in the surface of the concrete and bonded, be continuous through an expansion joint.

## 5-19. SEAL STRIPS.

(a) 16 gauge corrugated iron seal strips shall be provided across all monolith joints near the lock chamber face of both lock walls between approximate Station 400A and 1200B; see typical detail on the drawings. These strips shall extend practically vertically from the foundation to a point two feet below the top of the walls. In addition, all culverts and galleries shall be completely encircled with seal strips where they cross monolith joints between the Stations noted above. All seal strips shall be continuous, the end of adjoining sheets being lapped and welded for water-tightness. The entire surface of seal strips shall be covered with bituminous paint approved by the contracting officer prior to their embeddment in concrete. The corrugated iron sheets for seal strips shall conform to par. 6-09.

(b) Seal strips shall be paid for at the contract price per pound for "Corrugated Sheet Iron", furnished and installed as specified. No separate payment will be made for painting.

(c) If supply conditions at the time for construction permit the use of copper seal strips, the contracting officer may direct that they be substituted for the corrugated iron strips. In such event the contractor shall furnish and install the copper strips and the contract price will be adjusted for any difference in cost in accordance with Article 3 of the contract. Copper strips, is used, shall conform to par. 6-22.

## 5-20. MEASUREMENT AND PAYMENT.

(a) Concrete, General. - Measurement of concrete will be made on the basis of the actual volume of concrete within the neat lines of the structures as indicated on the drawings or otherwise required. Measurement of concrete placed against the sides of the excavation without the use of intervening forms will be made only within the neat lines of the structure. No deductions will be made for rounded or beveled edges or space occupied by metal work, electrical conduits, timber, nor for voids, which are either less than five (5) cubic feet in volume or one (1) square foot in corss section. Payment for concrete will be made at the respective contract prices per cubic yard for "Concrete ; Class "A"; of all equipment, tools, material, false-work forms and form lining, bracing, bolts, rods, metal ties, dowel, joint filler, canvas, mortar, labor, special provisons for hot and cold weather placing and curing, and all other items required to complete the concrete work except for materials to be furnished by the Governement, (see Par. 1-10) and embedded items for which separate payment is provided.

(b) Additional Concrete. - Any other concrete to be placed and not specifically covered above will be paid for at the contract unit price for the concrete specified above which is most applicable to the additional concrete placed as dtermined by the contracting officer. The decisions of the contracting officer regarding the classification of such additional concrete will be final. No payment will be made for any additional material which may be authorized by the contracting officer at the request of and primarily for the benefit of the contractor, which is not found necessary as required and directed by the contracting officer under the provisions of these requirements.

(c) Measurement and Payment for Steel Reinforcement. - Steel reinforcement furished by the Government will be paid for at the contract unit price per pound for "Steel Erection; Comcrete Reinforcing." The weights for payment shall be passed on the amount actually placed in accordance with the dimensions and details on the bar schedules furnished by the Government or placed as directed by the contracting officer. U it weights used in determining computed weights will be as follows:

| Size of Bars, Inches | Weight, Pounds per Foot |
|---|---|
| 3/8 round | 0.376 |
| 1/2 round | 0.668 |
| 1/2 square | 0.850 |
| 5/8 round | 1.043 |
| 3/4 round | 1.502 |
| 7/8 round | 2.044 |

| Size of Bars, Inches | Weight, Pounds per Foot |
|---|---|
| 1 round | 2.670 |
| 1 square | 3.400 |
| 1-1/8 square | 4.303 |
| 1-1/4 square | 5.313 |

## SECTION VI

## METALS AND MISCELLANEOUS MATERIALS

### 6-01. GENERAL.

(a) Materials. - All materials shall be of new unused stock, free from defects. Substitution of size of sections and materials from that shown on the drawings or required in the specifications shall not be made except on written approval of the contracting officer and provided that the cost to the Government shall not be increased thereby.

Materials indicated on the drawings or required in the work and not covered elsewhere in these specifications by detailed requirements, shall conform to the requirements of this section.

The detailed specifications herein might contain certain materials not required in the completed work, in which case the specifications therefor will not be applicable to the required work. Any materials required which are not covered by detailed specifications herein or elsewhere in the specifications shall conform to the applicable Federal Specifications, grade and/or class as required or, in case where there are no applicable Federal Specifications, to applicable specifications of the American Society for testing Materials (A.S.T.M.) In all other cases not specifically covered in these specifications the contractor shall furnish the highest grade commercial material or product.

(b) Inspection, Acceptance and Rejection of Materials. - All materials shall be subject at all times to inspection by the contracting officer who will select such samples in such quantities as he may deem necessary and subject the same to such tests as may be necessary to determine their qualities as herein specified, and he will accept or reject materials in accordance with the results of such tests. Tests may be repeated upon arrival of the various shipments at the site of the work as may be necessary to insure the acceptance of only such materials as will comply with the provisions of the plans and specifications.

(c) Test Specimens. - Special test specimens shall be furnished by the contractor on request; and shall be of such shape and number as designated; and shall in general conform to Federal Specifications or the specifications of the American Society for Testing Materials as to shape, size, and method of testing.

(d) Mill test reports. - Mill test reports certified to by qualified technicians shall be furnished when required for all material entering into this work and will, in general, be the basis of acceptance or rejection of the materials. The contracting officer may however, require of the contractor special chemical or physical test on any part of the material if in his opinion the conditions justify such a check.

6-02. FEDERAL SPECIFICATIONS. - Copies of Federal Specifications referred to herein may be procured from the Superintendent of Documents, Government Printing Office, Washington, D. C., at a price of five or ten cents each. When the term; "Federal Specifications" or "A.S.T.M. Specifications" is cited, the reference shall be construed to mean the specifications as modified by any amendments promulgated before the date of opening bids for the contract. The number and designation of the Federal Specifications or A.S.T.M. Specifications for various materials to be furnished under this contract are as hereinafter enumerated.

6-03. CAST IRON SAFETY TREAD. - Cast iron safety tread shall conform in all respects to Federal Specification RR-T-661, for "Treads; Safety, Metallic", Type "B" and Class "6". Safety tread shall have a minimum thickness of 5/16 inch, and shall be of the lengths and widths shown on the drawings. Safety tread shall have a diamond pattern and shall have a nosing of not less than 1/4 inch. Treads shall be set flush with the surface and shall be firmly anchored.

6-04. STRUCTURAL STEEL. - Unless otherwise specified, all steel for general purposes shall conform to Federal Specification QQ-S-711a for "Steel, Structural; (for) Bridges", Class "A", except that the chemical properties shall be so controlled as to permit it to be easily welded by the arc-welding process.

6-05. CHROMIUM STEEL. - Chromium Steel shall conform to Federal Specification QQ-S-751a for "Steel, Structural (Including Steel for Cold-Flanging) and Steel, Rivet; (for Ships other than Naval Vessels", with the following exceptions:

| Chemical Properties | Percent |
|---|---|
| Carbon | .10 maximum |
| Manganese | .10 to .30 |
| Phosphorous | .10 to . 20 |
| Sulphur | .05 maximum |
| Silicon | .50 to 1.00 |
| Copper | .30 to .50 |
| Chromium | .50 to 1.50 |

| Physical Properties | Lbs. per Sq. In. |
|---|---|
| Tensile Strength | 70,000 Minimum |

When annealing is required, each of the above tensile properties may be reduced 5,000 lbs. per sq. in.

Spot or Surface Conditioning will be permitted where it does not affect the strength or usefulness of the piece. For plate, sheet, strip, and bar shapes the maximum depth of grinding shall not exceed 7 percent of the thickness. For wide flange shapes and structural shapes weighing more than 50 pounds per foot, such conditioning shall conform to Federal Specification QQ-S-711, Amendment 1.

6-06. NICKEL STEEL. - Nickel Steel for structural purposes shall conform to A.S.T.M. Specification A8-39 for "Structural Nickel Steel."

6-07. CONCRETE REINFORCING STEEL. -

(a) Reinforcing steel to be furnished by the government will conform to Federal Specification QQ-B-71a, for "Bars; Reinforcement," (for) Concrete, "Type "B" (Deformed). Straight bars will be Grade 2 (Intermediate Billet Steel), Grade 3 (Intermediate Car Axle Steel) Grade 4 (Hard Billet Steel) or Grade 5 (Hard Rail Steel). All bent bars will be of Grade 2 (Intermediate Billet Steel) or Grade 3 (Intermediate Car Axle Steel.) The steel will be properly identified as to grade.

(b) Fabric reinforcement for concrete will be woven or electrically welded wire fabric of the type, weight and size shown on the drawings. The wire for fabric and for concrete pile reinforcing will conform to A.S.T.M. Specification A82-34 for "Cold-Drawn Steel Wire for Concrete Reinforcement."

6-08. SHEET METAL. - Sheet metal shall conform to Federal Specification QQ-I-696 for "Iron and Steel; Sheet, Black and Zinc Coated (Galvanized)" of the type and class as specified or required. When so specified, sheet shall also conform to definite chemical requirements.

6-09. CORRUGATED IRON. -

(a) Sheets shall conform to Federal Specifications QQ-I-696, type 1 except zinc-coating eliminated.

(b) Pipe shall conform to Federal Specifications QQ-C-806 type 1, except zinc-coating eliminated. The interior surface shall be cleaned, primed, and lined with coal-tar enamel, and the exterior shall be cleaned, primed, and coated with coal-tar enamel, Type A, with a bonded asbestos felt wrapper. All such materials and application shall be in accordance with the requirements of the American Water Works Association Specifications 7A.6.

6-10. CORROSION-RESISTING STEEL.-

(a) Rods, Bars, and Forgings. Rods, bars and forgings shall conform to Federal Specification QQ-S-763 for "Steel, Corrosion-Resisting; Bars and Forgings," unless otherwise specified, indicated or required, and all parts shall be subjected to thermal treatment to produce the maximum practicable resistance to corrosion. Thermal treatment shall avoid the sensitive temperature range between 900 degrees and 1,100 degrees Fahrenheit. All items to be subject to welding shall be delivered in the hot-rolled, pickled and annealed state.

(b) Plates, Sheets and Structural Shapes. - Plates, sheets, and structural shapes shall conform to U. S. Navy Department Specification 47-S-20a for "Steel, Corrosion-Resisting; Plates, Sheets, Strips, and Structural Shapes", Grade 3, unless otherwise specified, indicated, or required. All items to be subject to welding shall be delivered in the hot-rolled, pickled and annealed state.

6-11. STEEL FOR SPRINGS. - Steel for springs shall conform to A.S.T.M. Specification A 68-39 for "Carbon Steel Bars for Springs with Special Silicon Requirements".

6-12. COLD-ROLLED STEEL. - Cold-rolled steel shall conform to A.S.T.M. Specification A 108-36 for "Commercial Cold-Finished Bar Steels and Cold-Finished Shafting", "Open Hearth" grade, except that ultimate tensile strength shall be not less than 65,000 pounds per square inch. Rods, pins, keys and similar parts shall be of this material unless otherwise specified. Keys, unless otherwise specified, may be of A.A.E. Steel No. 1120.

6-13. MACHINE STEEL. - Machine Steel shall conform to A.S.T.M. Specification A 107-40 for "Commercial Quality Hot-Rolled Bar Steels". "Open Hearth, grade 0.15 to 0.20 carbon; or 0.20 to 0.25 carbon".

6-14. BOLT STEEL. - Bolt steel shall conform to Federal Specification FF-B-571a and Amendment No. 1, dated April 1935 for "Bolts; Nuts; Studs; and tap Rivets (and Material for Same)". Class "B" steel, unless otherwise specified or required.

6-15. STEEL FLOOR GRATING AND FASTENERS. - Steel floor grating and fasteners shall conform in all respects to Federal Specification RR-G-661a for "Gratings, Steel, Floor (Except for Naval Vessels)," and shall be made of the material and class as specified or required.

6-16. STEEL RAIL TRACK AND FITTINGS shall conform to the requirements of the current standard specifications of the American Railway Engineering Association. Rails shall be of the weight per yard as specified or required, and as shown on the drawings.

6-17. STRETCHER-LEVELED STEEL. - Stretcher-leveled steel sheets shall be of commercial low carbon structural steel conforming to the requirements of paragraph 7-04 and shall be cold-rolled and stretcher-leveled to a regular flat surface and full pickled to a smooth finish, or otherwise prepared in approved manner to produce similar results. The sheets shall be of the thickness or gage specified.

6-18. STEEL FORGINGS.

(a) Forged steel, unless otherwise specified, shall conform to A.S.T.M. Specification A 18-30 for "Carbon Steel and Alloy Steel Forgings", Class "C", except that shafts of this material not otherwise specified shall be of S.A.E. No. 1045 hot rolled, open-hearth steel forging bars.
(b) Forged Nickel Steel shall conform to the above A.S.T.M. Specification for Class "I", S.A.E. Steel No. 2340, with heat treatment VII, may be furnished for this class of forging. When authorized shafting may be hot rolled.

6-19. STEEL CASTINGS.

(a) Cast steel shall conform to Federal Specification QQ-S-681 for "Steel; Castings", Grades 1, 2, or 3 as required.
(b) Cast Nickel Steel shall conform to A.S.T.M. Specification A8-39 for "Structural Nickel Steel" in chemical composition and shall have a tensile strength not less than 85,000 pounds per square inch. Each casting shall be annealed.

6-20. IRON CASTINGS.

(a) Cast Iron. - Cast iron, unless otherwise specified, shall conform to Federal Specification QQ-I-652 for "Iron, Gray; Castings", of class as required.
(b) Cast Malleable Iron. Cast Malleable Iron shall conform to Federal Specification QQ-I-666 and Amendment 1, dated November 1934, for "Iron, Malleable; Castings", Black (Ungalvanized Type "A", and Zinc Coated (Galvanized) Type "B".

6-21. BRONZE.

(a) Phosphor Bronze. - Phosphor Bronze, unless otherwise specified, shall conform to Federal Specification QQ-B-746 and Amendment 1 dated November 1936, for "Bronze, Phosphor; Bars, Plates, Rods, Shapes, Sheets, and Strips", Grade "A" of type and temper as specified or required. Metal for springs shall conform to Federal Specification QQ-W-401 for "Wire; Phosphor-Bronze, Spring".

(b) Bronze Castings. Bronze castings shall conform to Federal Specification QQ-B-691a for "Bronze; Castings". Type 1 "Composition 2", unless otherwise specified or required.

6-22. COPPER

(a) Plate and Sheets. Copper plate and sheets shall conform to Federal Specification QQ-C-501 and Amendment 1 dated November 1936 for Copper; Bars, Plates, Rods, Shapes, Sheets, and Strips".

(b) Piping. - Copper piping shall conform in all respects to Federal Specification WW-T-799 and Errata -2, dated April 1934, for "Tubing; Copper, Seamless (For Use with Soldered or Flared-Fittings)", Type "K" or "L" as specified or required. Fittings for copper piping shall be die cast brass or copper fittings with capillary channel and feed holes for solder for sweating in place and shall bear the name of the manufacturer stamped thereon.

6-23. BRASS

(a) Sheets and Rolled or Drawn Shapes. - Sheets and rolled or drawn shapes shall conform to Federal Specification QQ-B-611a for "Brass, Commercial; Bars, Plates, Rods, Shapes, Sheets and Strips", Composition "C" of type and temper as specified or required. Metal for screws and bolts shall be composition "D", half hard.

(b) Castings.- Castings shall conform to Federal Specification QQ-B-621 and Errata 1 dated February 1934 for "Brass, Commercial and Naval; Castings", Composition "B" (Commercial brass castings).

(c) Pipe. - Pipe shall conform to Federal Specification WW-P-351 and Errata 1 dated October 1930 for "Pipe; Brass, Seamless, Iron-Pipe Size, Standard and Extra-Strong", Grade "A".

(d) Pipe Fittings.- Pipe fittings shall conform to Federal Specification WW-P-448 for "Pipe-fittings; Brass or Bronze (Threaded), 125-pound", or to Federal Specification WW-P-461 for "Pipe-Fittings; Bronze (Threaded), 250 pound", as specified or required.

6-24. SOLDER

(a) Solder shall conform to Federal Specification QQ-S-571 for "Solder; Tin-Lead", Grade "A" or "C" as specified or otherwise required.

(b) Solder for Brazing shall conform to Federal Specification QQ-S-551 for "Solder; Brazing", of composition as specified or otherwise directed.

(c) Silver Solder shall conform to Federal Specification QQ-S-561b and Amendment 1 dated June 1938 for "Solder; Silver", Grade as required.

6-25. BABBITT METAL. - Babbitt metal shall conform to Federal Specification QQ-M-161 for "Metal, Antifriction; Castings and Ingtos", Grade 3, unless otherwise specified or required.

6-26. ZINC. - Zinc shall conform to Federal Specification QQ-Z-351 for "Zinc; Slab (Spolter)", Grade "D".

6-27. LEAD. - Lead shall conform to Federal Specification QQ-L-171 for "Lead; Pig", Grade "A".

## 6-28. RUBBER FILLER FOR CONCRETE EXPANSION JOINTS.

(a) Cold Poured compound shall consist of a mixture of an aqeous dispersion of rubber, having a solid content of not less than 50 nor more than 70 percent, mixed with an inert material having a high surface area and which will not disintegrate through weathering. It shall be readily poured into the prescribed joints, shall set sufficiently within one hour to prevent infiltration of moisture or other foreign substances, and shall properly solidify or set within 24 hours after mixing to completely seal the joint and adhere to its concrete or steel surfaces. When kept at 70 degrees F. the joint shall be capable of being compressed at a rate of 1/10 inch per minute to 50 percent of its unstressed thickness and then elongated to a thickness 50 percent greater than its unstressed thickness for 3 cycles without showing any break or crack in the bond between the joint material and the concrete or in the joint material itself. Bond at 70 degrees F. shall not be affected by subjecting the joint to a temperature of 150 degrees F. for 96 continuous hours and then cooling to 70 degrees F., nor by freezing the water-saturated joint for 24 hours at a temperature of 70 degrees F. The material shall be similar and equal to "Joint Lok" as manufactured by Rubber Associates, Inc.. New York City.

(b) Hot Poured

Compound shall be a thermoplastic rubbery, resilient, adhesive material, suitable for being readily poured into the joint at a temperature of 400-450 degrees F., and of quick-setting type. The material shall remain homogeneous after prolonged heating at temperatures not lower than 450 degrees F., with no material change in character or viscosity. When poured, it shall solidify within 1 hour, shall adhere tightly to concrete, steel and bituminous surfaces, shall remain adhesive and resilient after prolonged exposure to freezing temperatures and to weathering, and shall be unaffected by dilute or concentrated solutions of calcium chloride. It shall have a softening point (Ring and Ball A.A.S.H.O. T-53) of not less than 80 degrees C. nor more than 95 degrees C. The material shall be similar and equal to "Thermoplastic" as obtainable from Dispersion Provesses, Inc., Naugatuck, Connecticut, or Rubber Associates, Inc., New York, or "Seals" as manufactured by Solvents and Plastics Co., Louisville, Ky.

6-29. LIME. - Lime shall conform in all respects to Federal Specifications SS-L-351, for "Lime; Hydrated (for) Structural Purposes", Type "M" or "F" as specified or required.

6-30. PUTTY. - Putty for glazing shall conform in all respects to Federal Specification TT-I-791a, "Putty; Pure-Lineseed-Oil, (for) Wood Sash-Glazing", or TT-P-781 "Putty and Elastic Compound; for Metal Sash-Glazing".

## 6-31. PLASTIC CORK.

(a) General. - Plastic cork filler or insulation shall consist of granulated cork, asbestos fiber, and bituminous binder, thoroughly mixed, and thinned with high volatile naptha to a suitable consistendy for application to concrete, metal, wood and expanded metal lath, and shall have an adhesive value not less than its internal strength of conesion when thoroughly set and dry.

(b) As taken from the container, the material shall be homogeneous and show no separation of ingredients that cannot be readily overcome by stirring. The cork content shall be no less than 67 percent by volume and the whole shall pass a No. 6 mesh sieve. The volatile material shall not exceed 55 percent by weight. Not more than 30 percent by weight shall be insoluble in carbon bisulphide, and such insolubles shall be wholly cork and asbestos fiber. After evaporation of the solvent, the soluble matter shall have a softening point at not lower than 165 degrees F., and shall show a penetration of from 8 to 20 at 77 degrees F. when tested in accordance with A.S.T.M. Specification D-5-25 for "Penetration of Bituminous Materials".

6-32. PREFORMED JOINT FILLER. Preformed joint filler shall be cork conforming to Federal Specification HH-F-341 for "Filler, Expansion-Joint, Preformed; Nox-Extruding and Resilient-Types (For Concrete)." Type II self-expanding cork, 1 inch thick.

6-33. SPECIAL BITUMINOUS CEMENT.

(a) Type "A". - Type "A" shall be an internal set-up cement of asphaltic base, composed of a liquid asphaltic fluxing agent with an admixture of powdered asphalt, asbestos fiber and other suitable inogranic fillers. When mixed in the proper proportions, the cement shall be suitable for proper trowel application, and shall harden to a consistency as specified in subparagraph (3) below:

(1) The material shall be supplied in containers of proper relative size to apportion batches with the desired troweling consistency. The liquid asphaltic fluxing agent shall be a smooth uniform mixture, not thickened or livered, and showing no separation which cannot be easily overcome by stirring. The powdered cement shall be a uniform mix containing no matted lumps of fibre.

(2) When mixed in the proportions recommended by the manufacturer, the cement shall yield no less than 80 percent of non-volatile matter when 10 grams are heated in an oven at 105 to 110 degrees Centigrade for 24 hours.

(3) When tested in accordance with A.S.T.M. Specification D-5-24 for "Penetration of Bituminous Materials". The above mixture shall have the following characteristics:

Immediately after mixing, using a 5/8 inch diameter steel ball, 114 grams, 5 seconds, the mixture shall permit a penetration greater than 300. The same specimen, after a lapse of 24 hours at 25 degrees C. under water, shall permit a needle penetration, 100 grams, 5 seconds, of not more than 100. The same specimen after a lapse of 30 days at 25 degrees C. under water shall permit a needle penetration, 100 grams, 5 seconds, of not more than 50.

(b) Type "B". - Type "B" bituminous cement shall be an internal set-up cement as specified for Type "A" except that, when mixed in the proper proportions, it shall yield not less than 85 percent of nonvolatile matter when 10 grams are heated in an oven at 105 to 110 degrees C for 24 hours.

(c) Type "C". - Type "C" cement shall be an internal set-up cement as specified for Type "A", except that it shall have a melting point of between 120 and 130 degrees F., and shall have a needle penetration of 77 degrees F., of not less than 80.

6-34. STEEL PIPE AND FITTINGS.

(a) Welded or Seamless Steel Pipe, Black or Galvanized, class and coating specified or required, shall be of standard commercial grade and sizes in conformity with Federal Specification WW-P-403a for "Pipe;

Steel and Ferrous Alley, Wrought, Iron-Pipe Size", except that test will not be required. Open ends shall be reamed. The pipe shall be straight, clean , and free from scale, rust, oil or other foreign matter. When listed on bills of material, random lengths may be furnished.

(b) Fittings. - Screwed fittings shall be of standard weight, malleable iron, conforming to Federal Specification WW-P-521a for "Pipe Fittings; Malleable-Iron (Threaded), 150 Pounds", galvanized, plain screw type. All fittings shall be of the same weight or grade as the pipe with which they are used.

6-35. WROUGHT IRON PIPE AND FITTINGS. - Wrought iron pipe and fittings shall conform to Federal Specification WW-P-441a for "pipe; Wrought-Iron, Welded, Black and Zinc-Coated", of the class and sizes as indicated or required. Open ends shall be reamed. The requirements in the specifications for fittings for steel pipe shall apply also to fittings for wrought iron pipe.

6-36. CAST IRON PIPE AND FITTINGS.

(a) Cast iron soil pipe shall conform to Federal Specification WW-P-401 for "Pipe and Pipe-Fittings; Soil, Cast Iron". When threaded pipe is required in lieu of bell and spigot, pipe shall conform to Federal Specification WW-P-356 for "Pipe, Cast-Iron: Drainage, Vent, and Waste (Threaded). Flanged pipe shall conform to American Standards, class as indicated or required.

(b) Threaded Fittings shall conform to Federal Specification WW-P-501a for "Pipe-Fittings: Cast Iron(Threaded)" of type and class as shown or required.

(c) Flanged Fittings shall conform to American Standards, class as indicated or required.

6-37. EMBEDDED HANGER SUPPORTS.

(a) Embedded Inserts for pipe supports shall be threaded rods similar and equal to the adjustable loop type manufactured by the Grinnel Company, of the sizes required.

(b) Expansion Shields and Sleeves for Pipe Supports shall be for threaded rods of the sizes shown on the drawings, and of the type approved by the contracting officer.

6-38. STANDARD BOLTS, SCREWS, AND PINS.

(a) Bolts, Nuts and Studs shall conform to Federal Specification FF-B-571a and Amendment 1, dated April 1935, for "Bolts; Nuts; Studs; and . Tap-Rivets (and material for same). Unless otherwise specified or required, bolts shall be of Type "B-2" and nuts of Class "C" steel, Type "A-2", with Class 3 medium fit. Zinc or cadmium coated bolts shall be furnished where specified, indicated or required.

(b) Machine and Set Screws shall conform to Federal Specification FF-S-91 for "screws, Machine: (including Screws, Set)" Class 3 medium fit, unless otherwise specified. Machine screws shall be of the type and material required. Set screws less than 3/8 inch in diameter shall be Type "D", and those 3/8 inch in diameter and over shall be of Type "G" unless otherwise specified or required. Four wrenches shall be furnished for each size of bolts and machine screws.

(c) Split Cotter Pins shall conform to Federal Specification

FF-P-368 for "Pins: Cotter Split" of the type as required.

6-39. LOCK WASHERS. - Lock washers shall be of the "Kantlink" type and shall conform to the S.A.E. standard dimensions and requirements, for lock washers of regular section. Material shall be either S. A. E. X1055 or S. A. E. 1060.

6-40. STEEL WIRE ROPE. - Steel wire rope shall conform to Federal Specifications RR-R-571 and Amendment 3, dated August 1939, for "Rope; Wire" of sizes and types as specified or otherwise required.

6-41. CHAINS AND ATTACHMENTS. - Chains and attachments shall conform to Federal Specification RR-C-271 and Amendment 2 dated November 1934, for "Chain and Attachments: Standard, Miscellaneous". Chains shall be Type "A", Grade "II", and as otherwise specified.

6-42. FLOOR PLATING. - Floor Plating indicated on the drawings shall be of carbon steel of the thickness specified or required, with a raised pattern on one side which will provide a non-skid surface in any direction. The reverse side of the plates shall be smooth. The specified thickness of the plate shall be exclusive of the raised pattern, which shall project not less than 5/64-inch and shall have a top free from sharp corners. They shall be closely spaced so that the foot will always be in contact with several of the raised portions.

6-43. TILES FOR GAGES. - Tile for Gages shall be 5 inch by 11-7/8 inch by 3-3/4 inch vitrified fire clay, ceramic glaze load bearing tile. Variation in face dimensions shall be not greater than 1/16 inch in length and 1/32 inch in width. Tile units shall be glossy white gazed on the face with corrugated sides and back. They shall produce a clear ringing sound when tapped with a metal hammer, and shall be free from chipping, spalls, blisters, and hair cracks. Numbers and graduations in glossy black as required shall be accurately and permanently fused into the glazed face of the respective units.

6-44. BACK WATER TRAP DRAINS. - Back Water trap drains shall be of the flapper valve type, of the sizes specified or required. The drains shall have a heavy cast iron body and be supplied with a heavy cast iron strainer. The back water valves shall be of brass. The flapper shall seat in an inclined position and the valve shall be so placed that its opening will be always submerged.

6-45. SPRINGS shall conform to A.S.T.M. Specification A-61-39 for Helical Steel Springs for Railways".

6-46. RUBBER.

(a) Moulded Rubber Seals shall be of the sizes and shapes indicated. They shall be reinforced with not less than 4 plys of 18 ounce per square yard cotton duck embedded in and following the contour of the finished seal near the center of its thickness. The rubber compound shall have the following physical properties:

| | |
|---|---|
| Tensile Strength | 3,000 pounds per sq.in. |
| Elongation | 500 percent |
| Durometer Hardness | 60 to 67.5 for exposed surfaces |

(b) Rubberized Fabric Seal shall be of the dimensions specified or required, and shall conform to Federal Specification HH-P-156 for "Belting: Conveyor (Rubber)", Type "A".

(c) Rubber cushions shall be of the dimensions specified or required and shall conform to Federal Specification HH-P-156 for "Packing and Gaskets; Rubber, Moulded, Sheet, and Strip", Grade "A".

6-47. GASKETS.

(a) Facing for oil lines shall conform to Federal Specification HH-G-46 for "Packing; Asbestos, Sheet, Compressed".

(b) Copper Asbestos Gaskets shall conform to Federal Specification HH-G-101 for "Gaskets; Metallic-Encased", Type "A", double jacketed, 1/8 inch thick.

(c) Low Pressure Gaskets 1/32 to 1/8 inch thick, for air, oil or water lines of less than 125 pounds per square inch pressure, shall be similar and equal to Type "CC" sheet packing as manufactured by the Crane Company.

6-48. FELT. - Felt shall conform to the requirements of the S.A.E. Standard Felt Specifications; for the oil retainer washers, S.A.E. No. F6 "Extra Firm Pad" 100 percent wool fiber; and for the oil gaskets, S.A.E. No. F15 "Firm Pad" 60 percent wool and 40 percent cotton fiber.

6-49. PRESSURE LUBRICATION FITTINGS. - Pressure lubrication fittings shall be of uniform and standard pattern similar and equal to "Alemite" pin type unless otherwise specified, authorized or required.

6-50. PRESSURE LUBRICANTS. - Grease for pressure lubrication, shall conform to Federal Specification VV-G-681 for "Grease; Lubricating, Mineral", "Medium" grade.

6-51. TILE GAGES. -

(a) Two tile gages accurately graduated in feet and tenth shall be constructed in recesses provided therefor in the masonry walls, supplemental drawings showing required markings and details of placement will be provided later. The tiles shall be soaked in clean water for not less than 24 hours immediately before placing. They shall be imbedded in white cement mortar, with sand content as directed by the contracting officer, completely filling the recess and all joints and air cells in the tiles. Horizontal joints shall be 1/8 inch and vertical joints 1/16 inch in width. All joints shall be neatly pointed with neat white cement mortar. Upon completion the entire surface of the gage shall be thoroughly cleaned with a weak solution of muriatic acid.

(b) Payment will be made at the contract price per linear foot for "Tile Gage," which price will include the gages constructed, secured in place, neatly finished and cleaned.

6-52. PIPE HANDRAILING. -

(a) All handrailing shall be of standard steel pipe conforming to paragraph 7-34, dimensioned and supported as indicated on the drawings.

Fittings shall be of malleable iron, ball pattern and shall have pinned slip joints.

(b) Payment will be made at the contract price per linear foot for "Handrailing; Steel Pipe," measured along the top rail between centers of posts at ends of each section. The contract price will include the attaching flanges, fittings pins, and anchor bolts.

6-53. MEASUREMENT AND PAYMENT.

(a) All metal work for which payment is not otherwise specifically provided will be paid for by the pound as determined by either scale weight or computed weight per fabricated peice for the various metals classified on the drawings. All computed weights for payment will be based on the dimensions indicated on the drawings. The contract prices will cover all necessary material and work for placing, fabricating and painting the metals and for providing any other protective coatings where specified. Payment for all bolts, nuts, pins, washers, expansion bolts, drift bolts and spikes three-eighths inch in diameter and over will be made at the contract price per pound for "Forgings; Steel", unless otherwise specifically provided. Babbitt, lead, zinc and other non-ferrous metals for which payment is not otherwise provided will be paid for as "Miscellaneous Non-Ferrous Metals".

(b) The weights of structural steel members and of castings shall be calculated according to the American Institute of Steel Construction Code of Standard Practice, as revised in January 1934, under the title: "Section 3, Invoicing". Sub-title: "(a) Weights", and printed on page 239 of the A.I.S.C. Manual "Steel Construction", edition of January 1934, except that the allowance for over-run of castings shall be five percent (5%), and except that no weight allowance will be made for painting but the cost of painting shall be included in the contract unit prices unless otherwise specified.

(c) The weights of all other parts shall be calculated from the net dimensions shown on the approved shop drawings, but without deductions for key-seats, bolt-holes, cotter-pin holes, oil grooves or similar minor cuts; such parts are those made of nickel stool, chrome-nickel steel, cold rolled steel, bronze, or other metals, including forgings, shafts, bushings, wheels, pins, axles, and miscellaneous machined parts. No weight allowance for painting of the parts described in this subparagraph will be made and the cost of painting such parts shall be included in the contract unit prices.

(d) Unit weights for metal work classified and paid for by weight as specified in this paragraph shall be as follows:

| | |
|---|---|
| Nickel Steel | .285 lbs. per cu. in. |
| Chrome nickel steel | .285 lbs. " " " |
| Iron Castings | .260 " " " " |
| Bronze, brass and copper | .311 " " " " |
| Babbitt metal | .270 " " " " |
| Lead | .409 " " " " |
| All other metals | .283 " " " " |

(e) All other materials for which payment is not specifically provided elsewhere will be paid for on the basis of the respective unit measures, as listed in the schedules at the contract unit prices.

(f) The contractor shall submit to the contracting officer calculated bills of materials in quadruplicate, showing in detail the material actually incorporated in the finished apparatus. These bills of material shall be prepared from the final shop drawings, and shall be figured according to the procedure described above.

(g) Partial Payment. Unless otherwise specified, estimates will be given for 60 percent of the contract prices for all metal work delivered and accepted at the site of the work, for which payment is on a pound price basis, provided such material be stored and protected from deterioration in a manner satisfactory to the contracting officer. The remaining 40 percent will be estimated when the material is incorporated in the work and accepted. If any material so stored and partly paid for, be not kept protected in a manner satisfactory to the contracting officer, no further partial payments on metal work as provided for in this paragraph will be made and the material will be kept protected by the contracting officer at the expense of the contractor.

## SECTION VII - METALWORK FABRICATION, ASSEMBLY, TESTS, TRIALS MISCELLANEOUS PROVISIONS, AND MEASUREMENT

7-01. - GENERAL WORKMANSHIP. Before laying out or working in any way material shall be thoroughly straightened by methods that will not result in injury. Finished members shall be free from kinks, bends, or winds. Shearing shall be neatly and accurately done, and all portions of the work neatly finished. Re-entrant cuts shall be made in the best possible manner; where they cannot be made by shearing, a rectangular punch may be used. Corners shall be square and true. Where approved by the contracting officer, flame cutting may be used instead of shearing or sawing. All places where flame cutting is proposed shall be definitely shown on all shop drawing submitted for the approval of the contracting officer. All bends, except for minor details, shall be made to cast iron dies. Where heating is required, precautions shall be taken to avoid overheating the metal and it shall be allowed to cool slowly. Babbitting shall be done in accordance with the best modern standard practice. All bolts, nuts, and screws shall be tight. All steel floor plate and steel floor grating shall be installed flush with adjacent curb surfaces.

7-02. RIVETING.

(a) Rivet holes, unless otherwise specified or authorized, shall be sub-punched or drilled at least 1/8 inch smaller than the nominal size of the rivet. Holes shall be reamed to a diameter not more than 1/16 inch greater than the nominal diameter of the rivet. Holes for field rivets shall be reamed after the work has been erected and bolted together in the field, but may be reamed in the shop if the entire work is assembled. All reamed holes shall be perfectly smooth, showing that the reamers have touched the entire circumference. The outside burrs on reamed holes shall be removed to the extent of making a 1/16 inch fillet. Where reaming is not required, the diameter of the punch shall be not more than 1/16 inch greater than the diameter of the rivet; nor shall the diameter of the die be more than 1/8 inch greater than the diameter of the punch. Poor matching of holes will be cause for rejection. Punching shall be accurately done. Drifting to enlarge unfair holes will not be allowed. For slight mismatching, reaming to a larger diameter for the next standard size of rivet may be allowed. Countersinking shall be neatly done.

(b) Rivets. - The size of rivets specified or required indicates the actual size of the cold rivets before heating. Rivets shall be hot driven with pressure tools wherever possible. Hand driving may be resorted to only in such places as are inaccessible to pneumatic tools. Rivets shall be free from slag and adhesive materials, and have heads of approved shape, full size, and concentric with shank. When driven, rivets shall completely fill the holes and be neat and finished. Recupping or calking shall not be done. Loose, burned, or otherwise defective rivets shall be cut out and replaced. In cutting out rivets, care shall be exercised to avoid injury to the adjacent metal. If necessary, they shall be drilled out. Unless otherwise specified or authorized, all countersunk rivets shall be chipped or ground flush. Rivets shall be uniformly heated to a light cherry red heat in a gas, oil, or electric furnace so constructed that it can be adjusted to the proper temperature, except that coal or coke of approved quality may be used for heating field rivets.

7-03. SPECIAL BOLTS. - Special bolts shall conform to Federal Specification FF-B-571a, for "Bolts; Nuts; Studs; and Tap Rivets (and material for same)" with diamensions and fits as specified below for the respective applications. Bolt diameters specified are those for standard nuts; where special wrenches are required at least 2 of each size shall be furnished.

(1) Bolts for Machinery Connections. Bolts and nuts for electrical machinery shall have class 2 free fit. Where operating machinery connections are made with spot faced and reamed holes, turned bolts shall be supplied, finished all over, with type "B-3" heads and type "A-3" nuts with class 3 medium fit. The body diameter shall be 1/16 inch larger than the threaded portion, and the unthreaded portion shall be 1/16 inch to 1/8 inch shorter than the thickness of the connected members. The bolts shall be fitted into holes reamed to provide 0.010 inch clearance.

(2) Turned Bolts for Structural Connections shall be finished all over, with type "B-3" heads and type "A-3" nuts. The body diameter shall be 1/16 inch larger than the nominal size for a rivet connection and at least 1/16 inch larger than the diameter of the threaded portion. The unthreaded portion shall be 1/16 inch to 1/8 inch longer than the thickness of the connected members. Bolt holes shall be reamed normal to the member during assembly to provide a drive fit for the bolts.

7-04. WASHERS. - Washers of not less than 1/8 inch thickness shall be used under all nuts except where holes are spot faced and unless otherwise specified, or required. Cut washers shall be of structural steel and Ogee washers of cast iron.

7-05. WELDING.

(a) General.

(1) Unless otherwise authorized, all welding shall be by the shielded electric arc welding process and shall conform to the provisions of the current specifications of the American Welding Society applicable to the work to be done, as determined by the contracting officer, and as further specified below. Welding operators shall be qualified, at the expense of the contractor, as required by the specifications of either the American Welding Society, the U. S. Navy Department Bureau of Construction and Repair, or the U. S. Bureau of Navigation and Steamboat Inspection, and the contractor shall certify by name to the contracting officer the welding operators so qualified, and the code under which qualified. In no case shall welding be done when the temperature of the metal is below 10 degrees F, or when inclement weather or physical conditions are such as may, in the opinion of the contracting officer, be unsuitable and impair the efficiency of the welder in making acceptable welds, unless approved steps are taken to correct such conditions.

(2) Inspection. The inspectors shall have the right to cut coupons from any location in any joint for testing. Should any 2 coupons cut from the work of any welder show strengths under test less than that of the base metal, it will be considered evidence of negligence or incompetence and such welder shall be permanently removed from the work.

(b) Filler Metal. -

(1) Unless otherwise specified or authorized all deposited weld metal shall have elastic limits and ultimate tensile strengths not less than those of the respective base metals; elongation within 5 per cent of that of the base metal; and chemical composition similar to that of the base metal. These properties shall be determined by testing in accordance with the applicable provisions of the current specifications of the American Welding Society.

(2) Welding Electrodes and rods shall be of type and grade as approved by the contracting officer and of such chemical composition and physical properties as will produce the characteristics specified above and so adapted to the base metal and thickness of parts to be welded as will insure effective penetration and an intimate uniform fusion of the filler and base metals. The electrodes and coating shall conform in dimensions and physical characteristics to applicable provisions of the current specifications of the American Welding Society.

(c) Special Workmanship Requirements.

(1) Welding Procedure. The contractor shall prepare his own schedule of welding procedure for each structure to be welded, and shall submit the procedure to the contracting officer for approval. The procedure shall be in accordance with best modern standard welding practice, as approved by the contracting officer, and shall be such as to minimize locked-up stresses and distortion of the finished members of the structure. No welding shall be done on any structure until the procedure for that structure has been approved. Approval of any procedure, however, will not relieve the contractor of the sole responsibility for its adequacy for producing a finished structure meeting all requirements of these specifications.

(2) Welds. A wandering or skip sequence of welding shall be used on all passes of welded joints. The maximum length of bead, laid in any one continuous or skip pass shall be that which can be laid with one electrode. Welds shall be of the type, size and dimensions as shown on supplemental detail drawings to be furnished later by the Government. Welds, 3/8 inch and larger, shall be made in not less than 2 passes; and, unless otherwise specified or authorized, shall in general be made with one pass for each 1/8 inch thickness of base metal, exclusive of back bead. No electrodes larger than 1/4 inch in nominal diameter shall be used unless authorized by the contracting officer. In all welding, the application of the first pass shall be given special attention to insure satisfactory penetration and fusion of the filler and base metals.

(3) Assembling Devices and Temporary Connections. Preparatory for welding, the assembled elements of members shall be held rigidly in position by the use of approved devices adapted to the purpose, and capable of exerting pressures requisite to remove local distortions and compress the parts into intimate contact except where root openings are required. Bolts may be used for temporary connections provided that the bolt holes are subsequently filled with sound weld metal in an approved manner and ground flush with adjacent base metal, unless otherwise authorized. Welding for temporary connections and bracing will be permitted provided that, where such welded connection does not form a part of a later permanent connection, such weld metal shall be removed approximately flush with adjacent base metal where so directed.

(d) Flame Cutting shall conform to the applicable provisions of the current specifications of the American Welding Society.

7-06. CORNER PROTECTION. - Coping curb and corner protection shall be constructed as shown on the drawings.
Sections shall be installed true in alignment and elevation so as to provide a uniform smooth surface, tangent and flush with the adjoining concrete surfaces. The concrete in contact with the metal and embedding the anchorage shall be carefully placed and thoroughly spaded to prevent voids or honey comb pockets.

7-07. METALLIC COATINGS. - Zinc coatings shall be applied in a manner and of a thickness and quality conforming to A.S.T.M. Specification A 123-33 for "Zinc (hot galvanized) Coatings on Structural Steel Shapes, Plates, Bars and their Products." Sherardizing and Cadium plating shall have thickness and durability equal to or greater than Zinc Coating applied as specified above.

7-08. MACHINE WORK.

(a) General. All tolerances, allowances and gages for metal fits shall conform to standards as approved by the American Standards Association, December 1925. Machine work shall be done wherever an "f" or any word denoting machine finish appears on the drawings and at other places where necessary. Where the "f" follows a dimension, both surfaces from which it is measured shall be machine finished so that they will be true to the dimensions shown. All finished contact or bearing surfaces shall be true and exact to secure full and complete contact. In machining and grinding fabricated pieces of cold-rolled steel, care shall be exercised that an equal thickness of the surface is removed from all sides. Journal surfaces shall be polished and all surfaces shall be finished with sufficient smoothness and accuracy to insure proper operation when assembled. All parts entering any machine shall be carefully and accurately machined and all like parts shall be interchangeable. All drilled holes for anchor bolts shall be accurately located and drilled from templates.

(b) Keys and Keyways shall conform to the requirements of the American Engineering Standards Committee, standards of 1932, unless otherwise specified or required.

(c) Pin Holes shall be bored true to gages, smooth and straight and at right angles to the axis of the member. The boring shall be done after the member is securely fastened in position by bolts or rivets as specified or otherwise required.

(d) Protection of Machined Surfaces. All machine finished surfaces shall be thoroughly cleaned of foreign matter and coated with a composition of white lead and tallow or other approved slushing grease for protection against rust. As a further protection, unassembled pins and bolts shall be wrapped with burlap to prevent the removal of the coating.

(e) Lubrication. Provisions for lubrication shall be in strict accordance with the arrangement and details as shown on the drawings and otherwise where necessary to properly lubricate moving parts. Before erection or assembly, all bearing surfaces shall be thoroughly cleaned and lubricated with approved high grade oil. After assembly, all lubricating systems shall be filled with a suitable approved lubricant.

7-09. UNFINISHED SURFACES. - So far as practicable, all work shall be laid out to secure proper matching of adjoining unfinished surfaces. Where there is a large discrepancy between adjoining unfinished surfaces, they shall be chipped or machined to secure proper alignment. Unfinished surfaces shall be true to the lines and dimensions shown on the drawings and shall be chipped or ground free of all projections and rough spots. Depressions or holes not affecting the strength or usefulness of the parts, with the approval of the inspector, may be welded.

7-10. PART IDENTIFICATION AND WEIGHT REQUIREMENTS. - Each casting shall have the mark number and the heat number cast upon it. Each forging shall have the mark number stamped upon it. Unless otherwise authorized by the contracting officer, the scale weight of each casting or forging shall be within 5 per cent of the weight as calculated from the dimensions on the drawings.

7-11. PATTERNS.

(a) A complete set of all patterns, core boxes, and templates for all parts detailed on the drawings or which are not the standard stock product of a commercial manufacturer, shall become the property of the United States, and shall not be used for work under any other contract unless specifically authorized or directed by the contracting officer. Dimensions of castings shown on drawings are finished dimensions.

(b) Patterns and Core Boxes for the various parts of the work to be done under this contract shall be well and substantially made from thoroughly seasoned "Grade (B) or Better" northern white pine. Built-up patterns and core boxes shall be securely glued and screwed together. Nailing will be permitted only on light sections. Screw holes shall be countersunk and neatly filled with wood plugs. Loose pieces shall be either dovetailed or fastened with pull-out dowels, and split patterns or core boxes shall have metal dowels at partings. No skeleton or sweep patterns will be accepted.

(c) All nail and tool marks on molding surfaces shall be filled with beeswax. All surfaces shall be sanded with No. 0 grade sand paper and finished with not less than 2 coats of shellac, colored in accordance with the standard for pattern colors of the American Foundrymen's Association.

(d) After use, all patterns and core boxes required to be furnished shall be thoroughly cleaned, varnished, crated and delivered in first class condition to the U. S. Engineer Office, Massena, New York, together with list of same in duplicate, before final payment is made. The contracting officer reserves the right to withhold any payment for the original parts made from any pattern, until such pattern is delivered. Any pattern and core box lost or damaged by the contractor, or in shipment shall be replaced by the contractor without charge to the United States.

(e) Boxes and crates for the packing and shipment of patterns and core boxes shall be substantially made and shall be put together with screws so that they can be used several times. Each box and crate shall be plainly marked to indicate its contents.

7-12. SHOP ASSEMBLY. - Unless otherwise specified, each complete machinery unit of each type furnished by the contractor, and other units or parts of the work where so specified or required, shall be fully assembled in the shop in accordance with the requirements of the detailed provisions referred to below. All assembly and disassembly work shall be performed in the presence of a Government inspector, and any errors or defects disclosed shall be immediately remedied by the contractor without cost to the Unites States. Before disassembling for shipment, each piece of each shop-assembled machine or structure shall be match-marked to facilitate erection in the field.

## 7-13. TESTS AND TRIALS.

(a) The contractor shall make analyses and/or tests to determine that all materials are in conformity with the specifications except where tests are waived or not required by the contracting officer. Such analyses and/or tests, except when waived or modified, shall be made as indicated in the respective detail specification or as otherwise required.

(b) The contractor shall furnish the contracting officer certificates listing the heat number and the chemical and physical properties of the metal from which each article or piece of the material was made. There shall also be furnished two lists, one from the shop indicating what pieces or members are to be made from the material ordered, and the other from the mills indicating what pieces or members are furnished from each heat or melt.

(c) When doubt exists as to the soundness of any part, such part may be subjected to an X-ray or Gamma-ray inspection at the discretion of the contracting officer, and the cost of such inspections will be borne by the United States.

(d) Each complete machinery unit of each type furnished by the contractor shall be tested in the shop in the presence of a Government inspector before being disassembled and shipped to the site. Such action, however, shall not relieve the contractor of responsibility for any fault in operation, workmanship or material that may later develop before the completion of his contract. After being assembled in place, all completed machines and all completed moving parts of the structure shall be tested as required in the detailed provisions referred to below to demonstrate to the satisfaction of the contracting officer that they meet specification requirements in all respects and are suitable for performing the work intended. Any defects disclosed by tests and trials shall be immediately remedied by the contractor without expense to the United States and a satisfactory test completed.

7-14. SHOP INSPECTION. - The contractor shall keep the contracting officer informed as to commencement and progress of the work. In accordance with Article 6 of the contract, the contractor shall at all times permit Government inspectors free access to all parts of mills, foundries or shops where work is being carried on under the contract and shall provide the necessary facilities and assistance for making thorough examinations. Unless waived in writing by the contracting officer, mill inspection will be required on all metals. The acceptance of any material or finished member by an inspector shall not prevent subsequent rejection if such material or member is later found to be defective.

7-15. LIST OF MATERIALS.- The contractor shall furnish the contracting officer copies of all purchase orders, mill orders, and shop orders for material, and work orders. The contractor shall also furnish a shipping bill or memorandum of each shipment of finished pieces or members, giving the designation mark and weight of each piece, the number of pieces, the total weight, and if shipped by rail the car initial and number. Copies of certificates of tests and shipping bills in triplicate and all orders in quadruplicate shall be mailed promptly to the United States Engineer Office, Massena, New York.

## SECTION VIII

## ELECTRICAL REGULATIONS, WORKMANSHIP, MATERIALS AND EQUIPMENT

### 8-01. STANDARD RULES AND SPECIFICATIONS

(a) Unless otherwise specified, all electrical materials, workmanship, and tests shall be in conformity with the current standard rules, regulations, and specifications of the following authorities:

(1) National Board of Fire Underwriters
(205 East Ohio St., Chicago, Ill.)

(2) National Electrical Manufacturers Association
(420 Lexington Avenue, New York, N. Y.)

(3) American Institute of Electrical Engineers
(33 W. 39th Street, New York, N. Y.)

(4) Bureau of Standards (National Electrical Safety Code), (Superintendent of Documents, U. S. Government Printing Office, Washington, D. C.)

(b) The electrical equipment will be subject to exceptionally severe moisture conditions and a wide temperature range. All insulation shall be selected for this condition, and all other parts of the equipment shall be designed so that they will not be injuriously affected by such exposure. Insulating materials subjected to high temperature or electric arcs, shall be of an approved refractory material.

(c) Equipment for the same, similar, or allied service shall be of the same manufacture and type, and when of the same rating, shall be interchangeable, All equipment shall be designed to require a minimum number of spare parts.

(d) The materials specified under this section shall be furnished only as required for the respective items of work and equipment shown and/or specified.

8-02. GAUGE OF WIRE CABLE AND SHEET METAL. - Gauge of wire cable and sheet metal specified herein and on the plans, is American Wire Gauge (A.W.G.) for electric wire and cable, and United States Standard Gauge (U.S.S.) for sheet metal, unless otherwise noted.

8-03. INSULATION RESISTANCE. - Insulation resistance as required under these specifications shall be determined by mean of a 500-volt, direct-current, direct reading ohmeter, and test reports shall indicate both the voltage applied and insulation resistance of the material tested.

8-04. WIRING. - Wiring shall constitute the furnishing and installing of all cable and wire required in the locations specified; the furnishing and installing of all cable and conductor terminals, junction boxes, supports, racks or shelves, as shown or required; the making of all connections and the proper placing, arranging, and identifying of all material, as specified or directed by the contracting officer. All wiring shall be in conduit unless otherwise specified, shown, or directed by the contracting officer.

8-05. INSTALLING METAL CONDUIT. - All ends of metal conduit shall be reamed to remove rough edges and burrs and all joints between lengths of conduit, and at switches, junction boxes, and fittings shall be watertight and shall provide electrical continuity of the conduit run so that it can be effectively grounded. All open circuit ends shall be capped, except when working on the run, to exclude dirt and moisture. Conduit runs shall be pitched to provide suitable drainage. No threadless fittings or running-thread joints shall be used in metal conduit runs. Any run of conduit extending through a construction joint, or changing from an embedded to an open run, shall extend not less than the threaded length plus 1-inch past the face of the concrete. All conduit bonds shall have a radius not less than that of standard factory bends. Field bends may be used if of the proper radius and carefully made with suitable tools so that the conduit is not flattened.

8-06. COPPER WIRE FOR INSULATED WIRE AND CABLE. Copper wire for insulated wire and cable shall conform to paragraph C-2, United States Navy Department Specification 14 C11 for "Cables: Electric, Insulated," dated March 15, 1934.

8-07. SOLDER FOR BRAZING. - Solder for brazing shall conform to Federal Specification QQ-S-551 for "Solder; Brazing," Composition B.

8-08. INSULATING MATERIAL FOR WIRES AND CABLES.

(a) The following insulating materials shall conform to United States Navy Department Specification 15 C11, for "Cables: Electric, Insulated," dated March 15, 1934, paragraph designations as indicated below:

(1) Rubber-filled Tape, paragraph C-8
(2) Asbestos Insulation, paragraph C-10
(3) Braids; Cotton and Asbestos, paragraph C-14

8-09. VARNISH.

(a) Insulating Varnish shall conform to United States Navy Department Specification 52-V-13a, for "Varnish: Insulating, for Electrical Purposes," grade as specified or directed.

(b) Asphalt Varnish shall conform to Federal Specification TT-V-51 for "Varnish: Asphalt," Grade B.

8-10. MOLDED INSULATION AND PARTS. - Molded insulation and parts shall conform to United States Navy Department Specification 17-I-14, for "Insulation; Electrical, Phenolic, Molded and Laminated, and Molds for same."

8-11. CONDUIT AND CONDUIT FITTINGS.

(a) Fiber conduit shall conform to the specification of the Electrical Section of the American Railway Association, edition of 1929, Section 18(a)(21), paragraphs 10 to 19 inclusive, except that the minimum wall thickness shall be 0.2 inches; and shall have drive joints.

(b) Fiber conduit spacers for duct lines shall be made of material similar and equal to "Masonite Tempered Presdwood" manufactured by the Masonite Corporation, thickness of material not less than ½ inch; or of ½ inch, 5 ply, fir plywood board, treated so as to be moisture resisting. The design of the spacers shall be submitted to the contracting officer for approval.

(c) Entrance bells for fiber conduit shall be of white glazed dry process porcelain, or of impregnated molded wood pulp or fiber, with a smooth, true uniform surface. They shall have a curved surface where the cable enters the manhole, and be provided with suitable means for anchoring in the concrete, and suitable sockets for making a water-tight joint between the conduit and the entrance bell.

(d) Rigid metal conduit shall be zinc coated and enameled on the inside and outside and shall conform to Federal Specification WW-C-581, for "Conduit; Steel, rigid, Zinc-Coated." For sizes 2-inch or less, tubing conforming to Federal Specification WW-T-806, for "Tubing; Electrical, Metallic," Type "C" may be substituted in locations approved by the contracting officer.

(e) Flexible metal conduit shall be of the concave, double strip type, consisting of steel strips helically wound with tight seams and finished so as to provide a smooth interior surface. It shall be galvanized, sherardized, or cadmium plated.

(f) Metal conduit fittings shall be galvanized, sherarized, or cadmium plated high test gray iron or malleable iron castings of the types and sizes required, specified or shown on the plans. They shall be approved by the National Board of Fire Underwriters.

8-12. SINGLE-CONDUCTOR, ASBESTOS-INSULATED, ASBESTOS-BRAIDED WIRE AND CABLE shall be standard stranded conductor, insulated with a layer of felted asbestos and 45 mils of closely woven asbestos outer braid, both with flame and moisture-proof impregnation. The thickness of felted asbestos shall be 90mils for sizes No. 2 to No. 4/0, inclusive, and 102 mils for sizes 250,000 c.m. to 500,000 c. m.

8-13. MOTORS FOR LOCK OPERATING MACHINES.

(a) Type. All motors shall be of the high-torque, high-slip, constant-torque, squirrel-cage induction type designed for full-voltage starting. They shall be of the inclosed, self-ventilated, splash-proof, and weather-proof constructions, as specified in sub-paragraph (d) below. Motors furnished by the Government shall be installed by the contractor as shown on the drawings.

(b) Rating. -

(1) Motors for the sector gate machines shall be furnished by the contractor and shall be rated 15/5 h. p. 900/300 r.p.m. synchronous speed, 2-speed, 2-winding type.

(2) Motors for fender boom machines will be furnished by the Government and will be rated 30/10 h.p. 900/300 r.p.m., synchronous speed, 2-speed, 2-winding type.

(3) Motors for the rope coupling devices for the wire rope fender pins will be furnished by the Government and will be rated 1/2 h.p. 600 r.p.m.

(4) Motors for the stiff-leg derrick machines shall be furnished by the contractor and shall be rated of such capacity as recommended by the manufacturer. (See par. 11-05).

(5) Motors for the lock unwatering pumps shall be furnished by the contractor and shall be rated of such capacity as recommended by pump manufacturer. (See par. 15-04).

(6) Motors for the swing span bridge shall be furnished by the contractor and shall be rated as recommended by the manufacturer, except that if practicable the motors for operating the bridge swinging and wedging machinery shall be of a size and type to permit interchangeability with those noted under (2) above.

(7) All the above motors shall be rated 440 volts, 3-phase, 60 cycles, 50 degrees C. maximum temperature rise for full-load for not less than 15 minutes on the low-speed winding. For each motor rating, the acceptance load tests to determine the temperature rise on both windings where provided shall be made consecutively, i.e., by immediately changing speed without stopping the motor. The speed-sequence shall be that which will produce the highest final temperature. Temperature rise shall conform to the standards of the American Institute of Electrical Engineers for an ambient temperature of 40 degrees C.

(c) Torque and Slip. At rated voltage and frequency, each motor, for each winding, shall have a static torque of not less than 250 percent of full-load torque (based on the high-speed winding) and the full-load slip shall not be less than 12 percent. The maximum torque shall be developed at approximately zero speed. The locked rotor current shall not exceed 400 percent of full-load current.

(d) Frames and End Brackets.

(1) Frames and end brackets shall be of cast iron, wrought iron, or fabricated steel, so designed that rain or snow driven from any direction in or above the mounting plane, will not enter the inside of the motor or bearings. This shall be accomplished by providing baffled air passages in each end bracket and in the frame as required to trap and drain water and to provide adequate ventilation. Other approved construction providing equal assurance of adequate protection and ventilation may be used. The direction of the air flow entering the baskets shall be approximately vertically upward, through opening near the mounting plane. Weep holes shall be provided as required to drain condensation. The mounting foot shall be integral with the frame. All dimensions and frames siz
shall conform to the N.E.M.A. standards.

(2) Eyebolts for handling motors, shall be provided in an approved location on all motors weighing more than 150 pounds net.

(e) Shafts shall be of high-grade, hot-rolled steel of adequate strength and rigidity, finished to size all over, and with polished journal surfac
The diameter at the bearings shall be larger than the diameter of the shaft extens
and the diameter under the core laminations shall be larger than the diameter at t
bearings. They shall be treated for corrosion resistance as specified in sub-para
(1).

(f) Connections and Terminals. All connection leads shall extend outside of the frame and be provided with standard separable connectors located in an approved terminal box of water-tight construction, equipped for conduit connection and rigidly attached to the motor frame. Provisions shall be made for two 1-1/2 inch metal conduits spaced 3 inches between centers, located in a vertical plane parallel to the motor shafts and entering the box from above through pipe-tapped holes. The motor leads shall be sealed with a compound of litharge and glycerine where they pass through the stator frame. The terminals shall be suitably marked in accordance with standard N. 30-2 of the N.E.M.A.

(g) Bearings. - The motors shall be provided with ball bearings conforming to United States Navy Department Specification 42-B-5b, for "Bearings; Ball," dated November 2, 1931, designed to facilitate removal and renewal, and to prevent escape of lubricant or entrance of foreign matter. Approved means shall be provided for applying lubricant and draining same without removal of the bearing housing or brake housing. When the brake housing is bolted to the motor end bell approved filler and drain pipes shall be provided with the ends accessibly located and with approved fittings. The bearing housings shall be of an approved splash-proof type, effectively preventing lubricant from coming in contact with the motor windings.

(h) Cores for stators and rotors shall consist of separately punched, thin laminations of the best quality electrical sheet steel suitably insulated from each other, assembled under heavy pressure to obtain a rigid assembly and secured to the shaft or frame in an approved manner. The slots shall be entirely free of burrs or other metallic particles which might injure the slot insulation.

(i) Stator Windings Shall be provided with Class "A" insulation made thoroughly water-proof and oil-proof with a sufficient number of coats of water and oil resistant solvent insulating varnish so that the motors will meet the requirements of paragraph 8-01(b) and 8-13(o). The insulating compound shall not show cracks due to contraction or expansion and shall not soften or run due to the operating temperature of the motor or change of the ambient temperature. A final coating of water and oil-resistant varnish which will dry with a smooth, glossy surface shall be applied. The windings shall be securely wedged in the slots to prevent vibration and wear. The slot wedges shall be of impregnated fiber or maple wood boiled in oil. The insulation shall not show deterioration due to repeated alternate wetting and drying. The coils shall be completely assembled in the stator before the application of the varnish and shall be completely immersed in the varnish bath. The stator assembly shall be hot before each application of varnish and shall be thoroughly baked after each application, until the varnish is thoroughly dry or cured.

(j) Rotor Construction shall be copper or copper alloy bars, brazed or welded to copper or copper alloy end rings, or of other approved construction.

(k) Treatment Against Corrosion. - Screw, bolts, pins, terminals, brush holders, studs, springs, hand hole cover bolts, shafts, and other steel parts shall be "Parkerized" or similarly treated in an approved manner to resist corrosion.

(l) Machine Work shall be accurate, of high quality, and in conformity with approved standard practice. Threads shall be in accordance with the "National Forms" as adopted by the U.S. National Screw Thread Commission for the types of threads required. Thread fits shall be Class 2.

Threads on all body-bound bolts shall be chased a sufficient length so that when the nut is tightened there will be approximately 1½ free threads under the nut, or the bolts shall be undercut an equivalent amount.

(m) Designation and Markings. - A name plate shall be provided on each motor, suitably attached to the frame. It shall clearly indicate the manufacturer's name, identification symbol, serial number and salient design features; such as type, power, no-load and full-load speed, voltage, frequency, full-load current and full-load torque.

(2) The serial number shall be die-stamped on the front end of the shaft and on the frame, under the nameplate.

(n) Painting shall conform to the requirements of Section XVII, unless otherwise required.

(o) Tests.

(1) All motors furnished by the contractor shall be tested in conformity with the A.I.E.E. standards. The dielectric test shall be made at 1880 volts for a period of one minute. One motor of each type and rating furnished under this contract shall be given complete tests at the factory. One motor of each type and rating, selected at random by the contracting officer, shall be completely submerged in ordinary tap water for a period of not less than 12 hours. It shall then, without drying, operate successfully at rated voltage, frequency and continuous-duty load until the insulation resistance to ground shall become constant at an approved value, and without any further drying, it shall then withstand the dielectric test specified above. The remaining motors shall be given the manufacturer's standard commercial test at the factory to determine that all similar motors furnished have approximately the same characteristics.

(2) Complete Tests, as specified in sub-paragraph(1) above, shall include the following:

Excitation Test
Impedence Test
Performance and Speed-torque Test (Prony brake or other approved equivalent method)
Temperature Test
Dielectric Test
Insulation Resistance Test
Cold and Hot Resistance Measurements (Stator windings)
Effectiveness of Enclosure

Graphic charts showing the results of the above tests, corrected to rated voltage, shall be furnished as follows:

Excitation test- Volts as abscissae vs. amperes and watts as ordinates.

Impedence test - Volts as abscissae vs. amperes, torque and watts as ordinates.

Performance test - Percent load as abscissae vs. efficiency, power factor, amperes, watts and percent slip as ordinates.

Speed-torque-test- Torque in pounds-feet as abscissae vs. speed in r.p.m. as ordinates.

(3) Test Reports recording all actual data obtained during the above commercial and complete tests, shall be furnished for each motor.

(4) Final Acceptance Test of the motors shall be made in conjunction with the final tests and trials of the respective operating machinery at which time all necessary adjustments shall be made.

(p) Data to be Submitted for Approval. - The following data for motors to be furnished by the contractor shall be submitted to the contracting officer for approval before commencing manufacture:

(1) Complete descriptive specifications of the motor, with necessary cuts, photographs, and drawings to clearly indicate the construction of the motor. Special emphasis shall be given to indicate the features for which approval is required.

(2) Outline dimension Drawings

(3) Typical characteristic curves, indicating the speed, power factor efficiency, current and watts input, all plotted against percent load as abscissae.

(4) Guaranteed values of power factor and efficiency, when operating on the high-speed winding only, for full-load, 3/4 load and ½ load.

## 8-14. BRAKES.

(a) General. - Tail Brakes for motors for wire rope fender machines will be furnished by the Government and shall be installed by the contractor as shown on the drawings. All brakes required for other motors shall be furnished and installed by the contractor. Brakes shall be spring-set shoe type with motor-operated release. The brake motor shall be wound for the same operating voltage as the motor with which the brake is to be used. The brakes shall be floor mounted as shown on the plans.

(b) Rating. - The torque rating of each brake shall be not less than 250 percent of the full-load torque of the motor with which it is to be used, all conditions of operation and inclosure considered. The time rating and temperature rise shall be not less than that of the driving motors.

(c) Inclosure and Protection. - The entire brake assembly including the motor, shall be inclosed in a water-tight, dust-tight, and moisture-resisting inclosing case of 1/4 inch boiler plate. Brake housings shall be split on the diagonal, and the motor shaft entrance shall be made water-tight by bolting the brake housing to the motor end bracket with copper-asbestos gasket. On brakes with "Thrustor" operated release, the "Thrustor" shall be of submergible construction.

(d) Adjustment shall be provided for varying the holding torque from zero to the full rating of the brake, and for adjusting the position of the shores. The brakes shall release at 85 percent of the rated voltage.

(e) Mechanical Construction. -

(1) Except for brake wheels, shoes and electrical parts, no cast iron shall be used in brake construction. All pins, fittings, and other miscellaneous small metal parts shall be of approved corrosion-resisting metal. Bearings shall be fitted with bronze or other approved bushings to prevent any binding of moving parts. Approved means for lubrication shall be provided for all bearings; all parts shall be painted in accordance with Section XVI.

(2) Machine Work shall conform to the requirements for the motor with which the brake is used.

(f) Windings shall be insulated and impregnated in the same manner as that specified for the motor windings.

(g) Designation and Markings. - Name plate shall be provided for each brake and attached to a part of the brake which ordinarily will not be renewed during its service life. They shall conform to standard practice and clearly indicate the manufacturer, identification symbols and serial number, and salient design features such as type, torque rating, voltage, and frequency.

(h) Tests.

(1) Each brake shall be adjusted to give its rated torque and then tested for successful operation in accordance with above requirements.

(2) Heating Test. - One brake of each type furnished by the contractor, to be selected at random by the contracting officer, shall be subjected to a heating test, at rated voltage and torque.

(3) Dielectric Tests and insulation resistance measurements of the coil windings, shall be made on all brakes furnished by the contractor.

(4) Submergence Test. - One brake motor of each type furnished by the contractor shall be tested for submergence in the same manner as specified in paragraph 8-13(o) for the motor with which the brake is used. If thrustor release is used the entire "Thrustor" assembly shall be tested for submergence

(i) Data to be submitted for approval before commencing manufacture of the brakes, shall be equivalent to that furnished for the motors with which the brakes are used.

(j) Final Acceptance Test of the Brakes will be as specified in paragraph 8-13(o)(4).

## 8-15. LIMIT SWITCHES.

(a) General. - Limit switches for motors for wire rope fender machines will be furnished by the Government and installed by the contractor as shown on the drawings. All limit switches required for other machines shall be furnished and installed by the contractor. Limit switches shall be submersible cam type. Each limit switch shall contain all the individual switches required for making and breaking all control circuits, interlocking circuits, visual signal light circuit and position indicating light circuits, necessary for the proper control and operation of the machine to which it is geared. The individual switches, together with suitable mechanism for their operation, shall be assembled in a totally inclosed submersible cast iron case with an easily removable cover held down by C-clamps. The joint between the case and cover shall be made with a suitable composition gasket held between machined surfaces. The setting of the contacts shall be as directed by the contracting officer.

(b) Construction. - The case in which the limit switch is inclosed shall be tapped to accommodate the connecting conduit. The case, cover, and conduit connection shall be submersible and the lead-screw shank shall enter the case through an approved stuffing box. An air valve shall be provided. All parts shall be "Parkerized" or similarly treated to prevent corrosion. Parts of the limit switch, such as bolts, nuts, screws, pins, washers, bushings, and bearings, shall be of brass or bronze. The lead screw shall be of manganese bronze. Switches shall be provided with suitable soldering terminals for connection to all external wiring. Each terminal shall be plainly die-stamped for identification. Insulating shields shall be provided where necessary to prevent arching between bare parts, and all insulating parts shall be thoroughly dried and impregnated with a compound to make them non-hygroscopic. Such shields and other insulating parts which may be subject to high temperature shall be of refractory material. The limit switch element arrangement and supports shall allow sufficient movement from the positions required by the drawings to permit final adjustment in the field. The inside of the case shall be given 2 coats of an approved water and oil resisting paint before assembling the mechanism.

(c) Lubrication shall be accomplished by means of pressure lubrication fittings of submergible construction.

(d) Switch Elements. - All switches shall be of the quick-make and quick-break type and shall close with a wiping motion. All contact surfaces shall be faced with a 1/32-inch layer of silver and shall be capable of easy replacement. The tripping mechanism shall be designed to reset the contacts in case the cams are not in the proper operating position.

(e) Accuracy. - The design of the switch elements and operating mechanism of the limit switch, shall permit accurate setting within the limits to be specified later.

(f) Tests. - The limit switch shall be tested at the factory for 600-volt dielectric for 5 minutes, for successful operation, and for submergence. The submergence test shall be made with the switch completely submerged in water and air pressure equivalent to a 15 foot head of water applied to the inside for a period of one hour, or other approved equivalent test, and there shall be no indication of leakage.

(g) Installation. - The limit switches shall be installed as indicated on the drawings or as otherwise approved by the contracting officer. The contractor shall provide and install necessary gears, gear guards, and other appurtenant parts.

8-16. TESTED EQUIPMENT AND SUPPLIES. - Tests on all equipment, supplies, and assemblies thereof, shall be conducted at the plant of the manufacturer and shall be as specified for the particular item. If no tests are specified, the equipment or assemblies shall be tested in conformity with the A.I.E.E. standards, N.E.M.A. standards, or procedure of the A.ST.M. The standards of the A.I.E.E. shall take precedence, if applicable.

8-17. PAYMENT.- Payment for all materials, supplies, tests, including temporary power and connections, and all other work under this section will be included in the respective contract prices of the items for which they are required.

## SECTION IX

## LOCK ELECTRICAL CONDUIT SYSTEM

9-01. GENERAL. - The conduit and manhole system for the future electric cables shall be located and installed as shown on the drawings. Additional detail plans of all manholes, pull-boxes, and conduits embedded in concrete will be furnished at later date. All workmanship and materials shall conform to the requirements of section VII.All conduit shall be fiber type except for connecting lengths required to extend into machinery recesses or elsewhere beyond the face of concrete. In such places rigid metal conduit shall be used.

9-02. MANHOLES AND PULL-BOXES. - Care shall be exercised in placing the forms, so that the interior surface of the completed manholes shall be smooth and uniform.

9-03. CONDUIT INSTALLATION.

(a) General. - The spacing of embedded conduits shall be as shown on future detail plans, and shall be supported by spacers at intervals of not more than 3 feet. The spacers and conduits shall be rigidly supported to prevent misalignment during concrete pouring. The detail of spacers will be shown on future detail plans. Spacers for 3 inch conduit may be used to support conduit of lesser diameter, if the conduit is suitably wedged in the over-size holes to maintain uniform pitch. All conduit shall be pitched to drain from a high point to a manhole or pull-box, except as otherwise specifically shown on the plans. The highest point in the run shall be covered by at least 12 inches of concrete and shall be located approximately in the center of the longest run. All conduits turning out of the run shall maintain the same pitch to the termination in the adjacent pull-box or manhole, except where the end bells are definitely located on the conduit turns upward, as at lighting or signal recesses. The concrete wall between conduits shall not be less than 2 inches thick at any point. All fiber conduits shall terminate with approved end bells, or metal conduit and bushings, excepting conduit for telephone lines, which shall be cut off flush inside the pull-box. Groups of end bells may be either precast to form the duct entrances, or assembled on the conduits before concreting. Where conduit passes through an expansion joint in the masonry, an expansion joint of the type required, shall be installed flush with the face of one monolith. All conduit joints shall be made water-tight with grade "B" asphalt varnish conforming to paragraph 8-09(b), which shall be so applied that none will enter the conduit. All conduit cut in the field shall have the ends properly machined with tools designed for the purpose, and all joints installed shall be of the same tapered construction as provided by factory cut material. All joints between fiber and metal conduit shall be made with special fiber couplings having one end tapered and the other end threaded. Where masonry monoliths are poured alternately, the conduit in the intermediate monoliths may be placed by cutting one length in each run, butting the cut ends together after alignment, covering the butted joint with a split coupling or metal sleeve rigidly fastened in place, taping the entire joint with 2 inch rubber tape and friction tape, and coating with asphalt varnish to make the joint water-tight. All conduit terminations shall be sealed with fiber plugs, metal caps or conduit bushings and "ponnies", before concreting operations are commenced. During concrete operations, extreme care shall be exercised to avoid damage to the conduit installation. Concrete shall not be poured directly on the conduits, and workmen shall not step on the conduits. The concrete shall be of a suitable mix and shall be carefully worked between and around the individual conduits so that each conduit will be completely enveloped in concrete without voids. Class "A" concrete shall be used around conduits and measurement for payment will be made between line 6" outside of the centers of outside conduits in each run.

(b) Initial Inspection. - As soon as possible after the concrete has set in a given lift, each conduit shall be cleaned and inspected for continuity and freedom from obstructions. The conduit shall be cleaned by means of a steel wire flue brush of suitable dimensions. A round, smooth, wooden mandrel shall then be passed through the conduit. For straight runs, the mandrel shall be not less than 3 feet long and shall have a diameter not less than 92 percent of the inside diameter of the conduit. For all conduit bends, the length of mandrel shall be reduced to a length approved by the contracting officer. When removed from the conduit, the mandrel shall not show any deep scratches or other evidences of rough surfaces within the conduit. Any defects in material or workmanship shall immediately be remedied.

(c) Final Inspection. - After each duct line is completed, each conduit shall be given a final inspection by repeating the initial mandrel inspection, and a continuous length of No. 9 gauge, solid, galvanized iron wire shall be left in each conduit for use in future cable installations. Conduit plugs shall have ½ inch holes drilled on the longitudinal axis for drainage and to permit sealing the conduit with the pulling wire in place.

(d) Location of Conduit Terminations shall be as shown on the plans or as directed by the contracting officer. All metal conduit leaving the concrete shall be accurately aligned in a direction normal (90 degrees) to the surface planes, to permit future extension.

9-04. ELECTRICAL GROUNDING SYSTEM. - Embedded ground cables, ground plates and ground connections shall be provided and installed as shown on the plans. All cable extensions from the concrete shall be provided as shown and shall be coiled, securely fastened to the face of the concrete and protected by an approved housing. No splices shall be made in any embedded ground cable. All ground cable shall be asbestos insulated copper cable conforming to paragraph 9-12.

9-05. PAYMENT.

(a) Payment for Conduit including all spacers, couplings, entrance bells and pulling wire, completely installed in place, will be made at the applicable contract price per linear foot for "Conduit; Fiber 3" dia." and "Conduit; Rigid Metal 2" dia." for the various sizes. Estimates for payment will be made for 25 percent of the contract price for material delivered and stored at the site of the work, in accordance with the requirement of paragraph 1-31. The remaining 75 percent of the contract price will be estimated for payment when the material is incorporated in the work and accepted.

(b) Payment for Grounding System, including all necessary conduit nipples, bushings and protective housings completely installed in place, will be made at the contract lump sum price for "Electrical Ground System."

(c) Payment for Other Material specified and/or required under this section, completely installed in place, will be made at the contract unit prices for the respective items.

## SECTION X - LOCK GATES

10-01. GENERAL. - The lock shall be provided with four identical sector gates, two at the upper end and two at the lower end of the lock. Each gate is 46 feet high and consists of two leaves. The gates shall be constructed, assembled and installed as shown on the drawings accompanying these specifications and in accordance with supplemental drawings to be furnished at a later date.

10-02. MATERIALS AND WORKMANSHIP.

(a) General.- All materials and workmanship shall be in conformity with the requirements of Sections VI and VII wherever applicable and as further specified below.

(b) Anchorage Bars.- Eye bars for gate anchorage shall be either of forged steel, Class "E", or standard rolled bar stock having the same physical and chemical properties, and shall be straight and true to size and free from twists, folds in the neck or head, or any other defect. Heads shall be made by upsetting, rolling and forging. Welding will not be allowed. The manufacturer shall guarantee the eye bars to break in the body when tested to rupture, and if required 2 bars shall be tested to rupture. Eye bars shall be annealed before boring. Turnbuckles for the eye bars shall be of the best quality forged steel, of standard dimensions and uniform in strength and section. Eye bars and turnbuckles will beclassed and paid for as "Forgings, Steel." Detailed demensions of eye bars will be furnished later by supplemental drawings.

(c) Pins shall be accurately turned to gates, straigh t and smooth, and entirely free from flows.

(d) Pilot Nuts.The contractor shall furnish such pilot and driving nuts as may be necessary for the proper erection of the work.

(e) Bronze Bushings shall be made for a drive fit, and shall be smooth and flush with the outside surfaces of the members in which they are placed.

(f) Pintles and Pintle Castings- The tops of pintles and the bronze pintle bushings shall be finished truly hemispherical and then polished. The bottom of the pintle shall be faced, and the body turned to accurately fit the lower pintle casting. The pintle and pintle bushings shall be so carefully made that they will be interchangeable.

(g) Hinges. - Hinge castings and bushings shall be so accurately made that they will be interchangeable among the several gate leaves. Hinge anchorages shall be structural steel grillages, details of which will be furnished later by supplemental drawings. The hinges shall be set so accurately with respect to the pintle as to permit final adjustment to exact positions without binding of any moving parts. Tolerances in initial setting and final adjustment will be specified when details of the pintle and hinge castings and the anchorages are furnished. Special care shall be exercised in setting the middle hinge to the true line between the center of the upper hinge and the center of the pintle.

(h) Calking - The joints in the skin plate faces of the gates shall be calked where necessary to insure water-tightness. No form of calking tool or work that injures the abutting plate will be permitted. When approved by the contracting officer, openings or seams may be welded by approved methods.

(i) Lubrication. - The pintles shall be lubricated through 1/2 inch extra-heavy brass pipes, provided with pressure lubrication fittings, extending to the top of the walkway. The pins at hinge and operating strut connections shall be drilled for lubrication.

10-03. HANDRAILING. - Handrailing shall be provided as shown on the drawing in accordance with paragraph 6-52.

10-04. TIMBER. - The gates shall be provided with white oak timber fenders and the gate recesses with white oak timber bumper blocks as shown on the drawi All timber work shall be in conformity with the requirements of Section IV.

10-05. ERECTION.

(a) Shop Erection. - In order to detect any errors in templates, the contractor shall erect at his works, without charge, one complete gate leaf. The leaf shall be carefully assembled, bolted together, and the rivet and bolt holes reamed. Any errors in the templates or elsewhere, found during the erection, sh be immediately corrected in each leaf. All pieces in each leaf assembled at the shop shall be clearly match marked, so as to facilitate erection in the field.

(b) Field Erection Plans. - Before beginning the field erection, the contractor shall submit for approval of the contracting officer, a detailed description with sketches in duplicate showing the method of erection proposed.

(c) Precautions During Erection. - In both shop and field erection, t utmost care shall be taken to get the skeleton into correct alignment before any rivets are driven. In the field erection, the separate parts shall be tightly bolted together, and the rivet and bolt holes shall then be reamed to their full size, if not reamed and matchmarked in the shop. All necessary precautions shall be taken in driving the rivets to avoid the distortion of the gate as a whole an of any of its component parts. Rivets shall be tight when test-hammered. The se beams in the sill shall be adjusted after final erection of the gate, and after final adjustment they shall be firmly grouted in place. Special care shall be us in setting the pintle and hinges to permit final adjustment of the gate to exact position without binding of moving parts and to insure proper bearing for gate lo

10-06. TRIAL OPERATION AND TEST. After erection and before final acceptan the gates shall be operated both in the unwatered condition and with the lock flo by moving the leaves back and forth by operation of the machinery throughout thei entire travel a sufficient number of times to demonstrate to the satisfaction of contracting officer that they conform to the specifications. The workmanship in gates shall be such that, when the leaves are closed, they will form a water-tigh barrier across the lock under maximum loads. There shall be no material leakage the miter, sill or side seals. The joints in the faces required to be watertight shall be tested with a pressure hose using a minimum pressure of 60 pounds per sq inch at the nozzle. This test shall be made after erection but prior to field painting. Any defects disclosed shall be corrected by the contractor without exp to the United States and satisfactory tests completed.

10-07. PAINTING. - Shall conform to the requirements of Section XVI.

10-08. PAYMENT. - for the complete gates, including construction, installat in place, testing and painting, and the required shop erection of one gate leaf be made at the respective contract unit prices for the various materials and ite used, in accordance with the provisions of Sections VI, VII, and XVI.

## SECTION XI - EMERGENCY DAMS

11-01. GENERAL. - The lock shall be provided with 10 emergency dam stop logs, types A, B, and C, a pick-up boom and a stiff-leg derrick at the upper end of the lock, and 10 emergency dam stop logs, types A, B, and C, a pick-up boom, and a stiff-leg derrick at the lower end of the lock. The emergency dam stop logs, pick-up booms, stiff-leg derricks and operating machinery shall be constructed, assembled and installed as shown on the drawings accompanying these specifications and in accordance with supplemental drawings to be furnished at a later date.

11-02. MATERIALS AND WORKMANSHIP. - All materials and workmanship shall be in conformity with Sections VI, VII, VIII, and XVI.

11-03. STOP LOGS. - The stop logs shall be constructed of structural steel in three sizes, type A. B. and C., as indicated on the drawings.

11-04. STOP LOG PICK-UP BOOM. - The stop log pick-up booms shall be constructed of steel pipe conforming to par. 6-34 framed and welded as indicated on the drawings. The pick-up booms shall be equipped with latching hooks and mechanism arranged to fit the pick-up lug castings provided on the stop logs.

11-05. STIFF-LEG DERRICK AND MACHINERY. - The stiff-leg derricks shall be commercial-type steel structures modified as required for the installation indicated on the drawings. The contractor shall design, furnish, erect and install the derricks and machinery. Each derrick shall be capable of handling a 45 ton load at 55 ft. radius.
Machinery for the derricks shall be commercial-type three drum hoists with slewing attachments, driven by electric motors. Each machine with the motor provided shall have sufficient capacity to hoist the 45 ton derrick design load at a minimum rate of 15 ft. per minute with the derrick provided, and to swing the derrick and lift the boom at rates customary in commercial practice for this type and size of equipment. Unit stresses, proportioning of members, connections, and other details of design of derricks and machinery shall be in accordance with usual practice for such structures and will be subject to approval by the contracting officer.

11-06. TRIAL OPERATION AND TEST. - After erection and before final acceptance, the stiff-leg derricks shall be operated a sufficient number of times to demonstrate to the satisfaction of the contracting officer that they conform to the specifications.

11-07. PAINTING shall conform to the requirements of Section XVI.

11-08. PAYMENT.

(a) Payment for the stop logs including construction installation and painting will be made at the respective contract unit prices for the various materials used in accordance with the provisions of Sections VI, VII, and XVI.

(b) Payment for the two stiff-leg derricks and machinery including design, construction, installation and painting will be made at the lump sum contract price "Stiff-Leg Derricks and Machinery".

(c) Payment for the two complete pick-up booms including construction and painting will be made at the contract price per pound "Pick-up Boom".

## SECTION XII - SECTOR GATE MACHINERY

12-01. GENERAL.

(a) Eight sector gate machines complete including motors, tail brakes and limit switches, shall be constructed and furnished and installed as shown on the drawings accompanying these specifications and in accordance with supplemental drawings to be furnished at a later date. All material and workmanship shall conform to the requirements of Sections VI, VII, and VIII wherever applicable. Each machine shall consist of an adjustable-length gate strut, sector arm, sector, a commercial-type, inclosed speed reduction unit, direct connected high torque, high slip, 2-speed, 2-winding squirrel cage induction motor, motor-operated shoe brake, and limit switch. All motors, tail brakes , limit switches and speed reduction units shall be interchangeable and of same manufacture. The general arrangement of the gate operating machinery shall be as shown on the drawings.

(b) The location of the center of the sector pin with relation to the center of the gate pintle shall be within a limit of 1/64 inch.

(c) The length of the gate strut shall be adjustable within a limit of ½ inch either way from the central position indicated on the drawings and detailed on later supplemental drawings, by means of the adjusting spanner bolts. When the adjustment is completed all the spring followers shall be seated tightly against the spring casing lugs, thus distributing the load equally between the springs for operation in either direction.

12-02. MOTORS, BRAKES AND LIMIT SWITCHES shall conform to the requirements of Section VIII.

12-03. WORKMANSHIP. - The machinery shall be placed in exact position and the parts to be concreted in shall be firmly wedged into place with steel wedges, after which the mortar shall be poured in and thoroughly tamped to bring all contact surfaces into bearing. The projecting mortar shall be neatly surfaced. All bolts, nuts, and screws shall be tight. Other details of workmanship shall conform to the requirements of Section VII.

12-04. PRESSURE LUBRICATION FITTINGS shall be provided and installed as shown on the drawings or otherwise where required for proper lubrication of moving parts of the machinery.

12-05. SHOP ASSEMBLY AND TESTS. - Each sector gate machine shall be completely fabricated, assembled and tested in the shop. The units shall be properly operated and closely checked to insure that all necessary clearances have been provided and that no binding occurs in any moving part. After satisfactory trial operations have been completed, the machinery may be disassembled for shipment to the site of the work.

12-06. PAINTING. - All painting shall conform to the requirements of Section XVI.

12-07. PAYMENT.

(a) Payment for sector gate machinery (except motors , brakes and limit switches), including construction, installation in place, testing and painting will be made at the contract price per pound for "Machinery, Sector Gates, Furnished and Installed".

(b) Payment for sector gate motors, brakes and limit switches including construction, installation in place, testing and painting will be made at the contract price per set for "Motors, Brakes, and Limit Switches for Sector Gates, Furnished and Installed".

## SECTION XIII -WIRE ROPE FENDERS

13-01. GENERAL. - The lock shall be provided with four wire rope fenders, three for 80 foot spans and one for 124 foot span, located as shown on the drawings. The wire rope fenders, including the operating machinery, shall be constructed, assembled and installed as shown on the drawings accompanying these specifications and in accordance with supplemental drawings to be furnished at a later date. The complete machinery units, including wire rope, fixed metal, motors, brakes and limit switches will be furnished by the Government and installed by the contractor as shown on the drawings. The fender booms shall be furnished and installed by the contractor.

13-02. MATERIALS AND WORKMANSHIP. - All materials and workmanship shall be in conformity with the requirements of Section VI, VII, and VIII, wherever applicable and as further specified below.

13-03. FENDER BOOM.- The booms shall be constructed of steel pipe conforming to par. 6-34 framed and welded as indicated on the drawings. The booms for the 80 foot fenders shall be made up of 4 sections, and the 124 foot boom shall be made up of 7 sections. The sections for the 80 foot booms and first 4 sections of the 124 foot booms shall be interchangeable. The pipe ends of all sections shall be equipped with suitable flanges to provide for bolting sections together.

13-04. MACHINERY.

(a) General. - The machinery furnished by the Government for the operation of the fenders will consist of all mechanisms and parts, including fixed metal, necessary to provide for raising and lowering the boom, coupling and uncoupling the ends of the wire rope, and for absorbing the energy of a striking vessel a ll as generally indicated on the drawings.

(b) Operating machinery for raising and lowering the boom consists of two cast steel rolling sectors with tooth treads operated by means of a crank arm a ttached to a shaft which is driven through a gear reduction unit by an electric motor, as shown on the drawings. The motors will be rated 30/10 H.P., 900/300 R.P.M. and provided with a tail brake and limit switch. The speed reduction gears with exception of the spring gear will be contained within a single inclosed unit of a commercial type. All speed reduction units for fenders will be inerchangeable and of same manufecture. Suitable counterweight units, made of concrete with steel punchings aggregate and proportioned as directed by the contracting officer, shall be furnished and installed on the rolling sectors for the 124 ft. span fender, as indicated on the drawings. These units shall be securely attached to the sector frame and shall be positioned so as not to interfere with operation of the fender. If necessary for the proper operation of the, three 80 ft. span fenders, as determined by the contracting officer, similar counterweights shall be provided for them also.

(c) Coupling pin machinery will consist of a 6 inch diameter pin forced through meshed sockets on the wire rope ends by means of a rack which is moved by a pinion connected through reduction gears to a motor, as shown on the drawings. The mechanism shall rotate the pin 90 degrees about its longitudinal axis after it is fully inserted in the rope sockets, for the purpose of locking the pin in place. The motor will be rated 1/2 H.P., 600 R.P.M. and provided with a limit switch. The speed reduction gears will be containedwithin a single inclosed unit of a commercial type. All speed reduction units for coupling pin machinery will be interchangeable and of same manufacture.

(d) Friction Brakes and Wire Rope. - Friction brakes for absorbing energy of a striking vessel shall be installed on both walls for each fender, each unit consisting of a brake reel and a fixed ballard as shown on the drawings. The brake reel consists of a nest of fixed and sliding discs adjusted to the required bearing by means of spring bolts. The wire rope will be 3½ inch diameter 6x37 construction conforming to par. 6-40, connected to machinery and boom as shown on the drawings.

(e) Motors, Brakes, and Limit Switches will conform to the requirements of Section VIII.

13-05. TRIAL OPERATION AND TEST. - After erection and before final acceptance, the fender booms and coupling pin machinery shall be operated a sufficient number of times to demonstrate to the satisfaction of the contracting officer that they conform to the specifications. Necessary adjustments for conterweights on the rolling sectors shall be made as directed by the contracting officer.

13-06. PAINTING Shall conform to the requirements of Section XVIII.

13-07. PAYMENT.

(a) Payment for complete wire rope fender booms, including furnishing, construction, installation in place, testing and painting will be made at the contract price per pound, "Fender Boom".

(b) Payment for installing wire rope fenders machinery (except motors, brakes, and limit switches) inclusing testing and painting, will be made at the contract price per pound, "Machinery, Wire Rope Fenders, Installed only".

(c) Payment for installing motors, brakes, and limit switches for the wire rope fenders, including testing and painting, will be made at the contract price per set for "Motors, Brakes, and Limit Switches, Wire Rope Fenders, Installed only".

(d) Payment for counterweights will be made at the contract price per cwt (100 lbs) for "Counterweight".

## SECTION XIV

14-01. GENERAL. - The contractor shall design, construct, furnish and install an unequal arm swing bridge complete and ready for the application of power for its operation and to receive highway traffic. The bridge is to be a riveted through truss for highway traffic and possible future railroad traffic with a 20 foot roadway and 2 3-foot sidewalks, with provisions for the future track on the center line of the bridge, designed for a Standard E60 Coopers Railroad Loading and a Standard H20 Highway Loading.

The bridge will span the lock, and in the open position will be set back from the face of lock wall to give a 5 ft. minimum clear passageway on the lock walls.

The opening of the swing will be approximately 95°-30' and the time for normal opening or closing, after release of ends, will be one minute.

The controls for operating this bridge will be fully automatic, located and worked from two central control points, which are provided for the operation of locks, one on each wall of the lock.

This bridge is to be supported on a center bearing, and shall have 8 balance wheels running on a track secured to the masonry.

The electric wiring will be under a separate contract.

14-02. MATERIALS. - The materials to be used shall conform to the requirements of Section VI and are to be as follows:

(a) Structural Steel. - For trusses, floor system, bracing, decking and machinery supports.

(b) Rolled Steel or Forged Steel. - For shafts, axles, bolts, nuts, keys, cotter pins, screws, worms, and piston rods.

(c) Forged Steel or Cast Steel. - For levers, cranks, connecting rods, and rollers.

(d) Forged Steel. - For pinions and equalizing levers, and shafts.

(e) Cast Steel. - For pivot stands, couplings, wedges, and shoes, racks, tracks, gears, brake wheels, shaft bearings.

(f) Tool Steel. - For parts which require hardening or oil tempering, such as pivots, friction rollers, ball bearings and spring.

(g) Phosphor Bronze. - For pivot discs and worm wheels.

(h) Phosphor Bronze, Bronze, or Babbitt Metal. - For linings of journal boxes and of other rotating or sliding parts.

14-03. WORKMANSHIP. - All workmanship shall conform to the requirements of Section VII of these specifications, as shown on the drawings, as hereinafter specified or in accordance with standard approved modern bridge shop practice.

(a) Punching, Reaming and Drilling Holes. - All connections of main truss members to gussets and splice material whether for shop or field rivets, all connections of stringers and floor beams whether for shop or field rivets, all connections of diaphragms to cross girders at L6 and to the trusses, end of cross girders to the trusses, and all connections for drive pinion supports to trusses shall be punched and reamed or drilled. Holes in other connections may be punched if material is 3/4" or less, and if material is over 3/4" it shall be punched then reamed or drilled. Reaming shall be done only after the pieces are assembled.

(b) Shop Assembly and Match Marking. - The trusses are to be assembled in shop and connection holes drilled or reamed. Cross girders at L6 are to be assembled in shop with the diaphragms, supports for drive pinions and connections to trusses and connection holes drilled or reamed. The floor beam connections and stringer connections are to be assembled in shop and drilled or reamed. All parts assembled in the shop for reaming or drilling field connecting holes are to be match-marked.

(c) Rack and Track. - Track segments shall be planed on the top, bottom and sides. Surfaces on which balance wheels bear shall be planed to the true bevel. The center line shall be scribed on the surface. The toothed segments forming the rack shall be fitted accurately.

(d) Pivot and Disc. - The pivot stand and center casing shall be finished and fitted accurately. The steel discs shall be of tool steel, fitted and finished, then oil tempered. After hardening they shall be ground to a final finish. The sliding surfaces of steel and phosphor bronze discs shall be polished.

(e) Assembling Centers. - The complete center, including girders, diaphragms, rack, track segments, shafts, gears, drive pinions and balance wheels shall be assembled in the shop and aligned, fitted, drilled and the parts match-marked.

(f) Camber. - The camber of trusses shall be equal to the deflection produced by the dead loads, making proper allowances for the lift of ends. The camber of the cross girders at the pivot support shall be equal to the dead load only .

## 14-04. DESIGN AND DESIGN COMPUTATIONS.

(a) General. - The bridge shall be designed for the following conditions:

Case I - Dead Load - Bridge open

Case II - Dead Load - Bridge closed and ends raised to give a positive reaction.

Case III - Live load on one arm - simple span action

Case IV - Live load on one arm - partially continuous girder action.

Case V - Live load on both arms - partially continuous girder action.

The combination of Case I alone, Case I plus Case II, Case I plus Case V, Case II plus Case IV, Case II plus Case V shall be used in determining maximum stresses.

(b) Impact. - Stresses in structural parts caused by the forces applied for moving or stopping the span shall be increased 100% as an allowance for impact.

(c) Reversal of Stress. - Structural members subject to reversal of stress during the movement of the span, shall be proportioned for resultant stress of either kind increased by 25% of the smaller. Secondary stresses shall be provided for in proportioning.

(d) End Lift Reactions. - The end lift machinery shall be proportioned to exert an uplift equal to the maximum negative end reaction of the live load and impact plus 50% of their sum.

14-05. ALLOWABLE WORKING STRESSES. - The following allowable working stresses are to be used:

(a) STRUCTURAL STEEL

| Nature of Stress | Maximum Stress | Formula Used |
|---|---|---|
| TENSIONS | | |
| Rolled steel, on net section | 18,000 | |
| On the area of the nominal diameter of rivets under the limitations defined in Section 13- | 13,500 | |
| COMPRESSION | | |
| Rolled Steel, on short lengths or where lateral deflection is prevented | 18,000 | |
| On gross sections of columns with a maximum of | 15,000 | $\frac{18,000}{1+L^2/10888r^2}$ |
| For main compression members, the ration L/r shall not exceed 120, and for bracing and other secondary members, and single lacing not to exceed 140 and for double lacing not to exceed 200. | | |
| BENDING | | |
| On extreme fibers of rolled section, and built-up sections, net sections, if lateral deflection is prevented | 18,000 | |
| When the unsupported length L exceed 15 times b, the width of the compression flange, the stress in pounds per square inch in the latter shall not exceed- | | $\frac{20,000}{1+L^2/2000b^2}$ |
| The laterally unsupported length of beams and girders shall not exceed 40 times b, the width of the compression flange. | | |
| On extreme fivers of pins, when the forces are assumed as acting at the center of gravity of the pieces | 27,000 | |
| SHEARING | | |
| On Pins | 13,500 | |
| On power-driven rivets | 13,500 | |
| On turned bolts in reamed holes with a clearance of no more than 1/50 of an inch | 13,500 | |
| On hand-driven rivets | 10,000 | |
| On unfinished bolts | 10,000 | |

| Nature of Stress | Maximum Stress | Formula Used |
|---|---|---|
| On the gross area of the webs of beams and girders where h, the clear distance between flanges in inches, is not more than 60 times t, the thickness of the web in inches | 12,000 | |
| On the gross area of the webs of beams and girders if the web is not stiffened where h is more than 60 times t, the greatest average shear per square inch, V/A, shall not exceed | | $\frac{18{,}000}{1+h^2/7200t^2}$ |

| BEARING | Double Shear | Single Shear |
|---|---|---|
| On Pins | 30,000 | 24,000 |
| On power-driven rivets | 30,000 | 24,000 |
| On turned bolts in reamed holes | 30,000 | 24,000 |
| On hand-driven rivets | 20,000 | 16,000 |
| On unfinished bolts | 20,000 | 16,000 |

On expansion rollers per linear inch, 600 times the diameter of the roller in inches.

COMBINED STRESSES. For combined stresses due to wind and other loads, the allowable working stress may be increased 33-1/3 percent, provided the section thus found is not less than that required by the dead and live loads alone.

MEMBERS CARRYING WIND ONLY. For members carrying wind stresses only, the allowable working stresses may be increased 33-1/3 percent.

(b) Machinery and Similar Parts, in which main stresses are not increased by impact:

| Material | Tension | Compression | Fixed Bearing | Shear |
|---|---|---|---|---|
| Rolled or forged steel | 9,000 | 9,000-40L/r | 13,000 | 6,500 |
| Stress in extreme fibers of trunnions | 13,000 | 13,000 | | |
| Cast Steel | 7,000 | 8,000-35L/r | 10,000 | 5,000 |
| Phosphor-bronze | 6,000 | 6,000 | | 4,500 |
| Cast iron | 1,500 | 8,000* | 8,000 | 2,000 |
| Keys | | | 9,000 | 5,000 |

*For struts whose L/r is 20 or less.

For stresses which are reversed at the rate of 10 or more times a minute, 2/3 of the above mentioned unit stresses shall be used.

(c) Bearing Pressures, for rotating and sliding surfaces in pounds per square inch:

(1) For intermittent motion with speed not exceeding 100 feet per minute:

Pivots of swing bridges, hardened tool steel on phosphor-bronze discs- - - -3,000

| | |
|---|---|
| Trunnion bearings, structural steel on phosphor-bronze | 1,500 |
| Wedges, cast steel on cast steel on structural steel | 500 |
| Screws which transmit motion (on projected area of thread) | 200 |

(2) For speeds exceeding 100 feet per minute:

| | |
|---|---|
| Hardened steel on hardened steel | 2,000 |
| Hardened steel on bronze | 1,500 |
| Structural steel on bronze | 600 |
| Structural steel on babbitt metal or brass | 400 |
| Structural steel on cast iron | 400 |
| Cross-head slides (speed not exceeding 600 feet per minute) | 50 |

(d) Journal and Pivot Bearings. - The pressure on pivots or step bearings for vertical shafts, and on journals, shall not exceed:

On pivots, $p = \frac{60,000}{nd}$, but not more than 900.

On journals, $p = \frac{250,000}{nd}$, but not more than 600.

On collars, $p = \frac{50,000}{nd}$, but not more than 200.

$p =$ pressure in pounds per square inch.
$n =$ number of revolutions per minute.
$d =$ diameter of pivot or journal or mean diameter of collar in inches.

For crank pins and similar joints with alternating application and release of pressure, the bearing values given by the foregoing formulas may be doubled.

(e) Shafts. - Circular shafts, trunnions and axles shall be proportioned by the following formulas:

$$f = \frac{32}{\pi d^3} \left( \frac{3}{8} M + \frac{5}{8} \sqrt{M^2 + T^2} \right.$$

$$S = \frac{16}{\pi d^3} \sqrt{M^2 + T^2}$$

$f =$ unit extreme fiber stress in tension or compression.
$S =$ unit shear.
$d =$ diameter of shaft at the section considered.
$M =$ simple bending moment computed for the distance center to center of bearings.
$T =$ simple twisting moment.

In the case of reversal at the rate of 10 or more times a minute, increase M by 1/2. In this case, f shall not be reduced on account of reversal.

If a shaft, trunnion, or axle has one keyway at the section where the maximum stresses occur, f and S shall be considered to be increased by 1/6; if two keyways, by 1/4.

(f) Gear Teeth. - In spur gears and bevel gears, the load transmitted shall be taken as applied on 1 tooth only; in worm wheels, as being equally distributed between 2 teeth.

A standard shaped tooth is one having the following characteristics:

(a) The profile is a 20 degree involute curve;
(b) The radial height outside of the pitch circle is closely 0.32 of the circular pitch;
(c) The thickness of the tooth at the pitch circle is 1/2 of the circular pitch.

The allowable load on cut gear teeth of standard shape shall conform to the following formulae:

$$W = psf\left(0.154 - \frac{1.912}{n}\right)\frac{600}{600 + V}$$

$W$ = the allowable load on the tooth in pounds.
$s$ = the permissible stress in pounds a square inch;
= 9,000 for bronze
= 16,000 for steel
$f$ = width of face of tooth in inches.
$p$ = circular pitch in inches.
$V$ = velocity of pitch circle in feet a minute.
$n$ = the number of teeth in the gear.

The allowable load on machine molded teeth shall conform to the foregoing formula, taking $s = 14{,}000$ for cast steel.

For teeth not of standard shape, the following formula shall be used:

$$W = \frac{sft^2}{6r} \times \frac{600}{600 + V}$$

$t$ = thickness of tooth in inches at section under consideration.
$r$ = radial height of tooth in inches measured from section where t is taken.

The other symbols are defined as in the formula for standard teeth.

For calculating the teeth of bevel gears, the middle section of the tooth shall be taken.

The teeth of gears transmitting power for the operation of the bridge, bevel gears, and wheels in the gearing of any motor, shall be machine cut.

14-06. DRAWINGS. - The swing bridge outline drawings furnished by the contracting officer indicate the neat lines of concrete lock walls with the necessary dimensions of the trusses, deck, walkway clearances on top of the lock wall, a diagrammatic outline showing the closed and open position of the bridge and a diagrammatic layout of machinery. The contractor shall without charge to the United States, submit design computations and stress sheets, in addition to detail drawings as specified in par. 1-04(c).

14-07. MACHINERY.

(a) General. - The machinery shall be simple and substantial in design, mounted on self-contained steel frames or bases, securely bolted to the bridge steel work, and located within easy access for inspection and servicing. The contractor shall furnish an outline drawing of the machinery, showing forces acting on the gear teeth, the twisting moment and the bending moment of shafts, and other information necessary for computing the strength of the machinery parts, together with detail and assembly drawings so complete that machinery parts may be duplicated without reference to patterns, other drawings or individual shop practice.

(b) Proportioning Machinery and Determining Power. - The machinery shall be proportioned and power provided to move the span under the following conditions:

(1) In normal time of opening: - with a wind load of 2 1/2# per square foot of the vertical projection of one arm plus frictional resistance and inertia.

(2) In twice the normal time of opening: - with a wind load of 10# per square foot on the vertical projection plus frictional resistance and inertia plus an ice load of 2 1/2# per square foot of floor area.

(3) With a wind load of 15 lbs. per square foot on the vertical projection of the bridge, the machinery shall hold the bridge in any position.

(c) Machinery Resistance. - The resisting forces shall be reduced to a single force acting between the pinion and operating rack, and the friction on the center discs in starting shall be 15%, and in motion 10%.

(d) Brakes. - The brakes shall conform to the requirements of paragraph 8-14. In addition the bridge machinery, including brake mechanism, shall be sufficient to stop the bridge in 5 seconds. The braking capacity shall be sufficient to stop the bridge in 10 seconds. If brakes act through machinery, the unit stresses produced in machinery by braking shall not exceed 1 1/2 times those allowed for normal torque of the prime mover.

(e) Aligning and Locking. - The contractor shall furnish suitable mechanism to align and lock the bridge securely in position, so that the bridge cannot be displaced either horizontally or vertically under the action of traffic. The operating mechanisms of end lifts and rail locks shall be independent.

(f) Interlocking. - The bridge operating devices shall permit interlocking with the signal system, and the devices shall be so interlocked with each other that the operations for opening and closing of the bridge will be performed in a predetermined order.

(g) Limit Switches. - Motors are to be provided with limit switches to control the various operations and shall meet the requirements of par. 8-15.

14-08. ELECTRICAL EQUIPMENT.

(a) General. - The contractor shall furnish and install the electrical equipment for the operation of the bridge up to the leads for the power to the motors, brakes and limit switches. The wiring from these points to the control panels and to the sources of power are under a separate contract.

(b) Motors. - The contractor shall furnish and install all the motors for the operation of the bridge in accordance wit Section VIII.

(c) Current Requirements. - A curve showing current required by the motors at the various stages of operating the swing span is to be furnished by the contractor.

14-09. HIGHWAY AND SIDEWALK DECK

(a) Highway Deck shall consist of open steel mesh deck grating as made by the Irving Iron Works Company or equal, and is to be welded to transverse sills supported on stringers.

(b) Sidewalk Deck shall be similar grating bolted to a reinforced concreted curb and a longitudinal steel channel.

14-10. HANDRAILS. - The hand rails for the sidewalk are to be extra strong, wrought iron pipe with malleable fittings, consisting of two lines of 1 1/2" Ø pipe with 2" Ø posts.

14-11. COUNTERWEIGHT. - The counterweight shall be of Class B (see par. 5-03.) concrete, supported by structural steel frames, and is to be made with pockets easily reached for adding or removing concrete balance blocks. Test blocks of concrete exactly like the concrete to be used in the counterweight are to be made to measure the probable unit weight. Before the construction of the counterweight, the contractor shall determine the weights carefully from shop plans of all structural metal and machinery, deck material and counterweight material in the structure, and adjust the counterweight to give a good balance to the structure.

14-12. ERECTION. - Before starting work, the contractor shall inform the contracting officer fully as to the method of erection he proposes to follow, and the amount and character of equipment he peoposes to use, which shall be subject to the approval of the contracting officer. The contractor shall submit plans for falsework, if required, to the contracting officer.

14-13. PAINTING. - Painting of bridge and machinery shall conform to Section XVI.

14-14. TESTS AND OPERATION.

(a) Machinery Test. - Before the main machinery is connected for transmitting power, it shall be given an idle run of 8 hours.

(b) Hand Operated Test. - All machinery shall be hand operated for one cycle of operation before being electrically operated.

(c) Completed Test. - All operating machinery shall be put through successive cycles of operation for a period of one hour. All bearings shall be inspected to detect the heating of parts, and any defects found in the adjustment of machinery shall be corrected, and an additional cycle of operations for one hour shall be made until all parts operate successfully.

14-15. SUPPLEMENTARY SPECIFICATIONS. - Wherever any points are not specifically covered by these specifications, the following specifications shall govern:-

(a) Specifications for Movable Railway Bridges - issued by the American Railway Engineering Association. - 1935.

(b) General Specifications for Steel Railway Bridges, issued by the American Railway Engineering Association. - 1940.

(c) Spare parts will not be required for the equipment on this bridge.

14-16. PAYMENT.

(a) Payment for the "Swing Bridge" and machinery will be made at the contract price for the design, furnishing, fabrication, erection and painting of the bridge and machinery, including fixed metal and all other parts necessary for the complete bridge.

(b) Partial Payments. - A partial payment of 60% will be made on the estimated value of materials for the "Swing Bridge" and Machinery when the material arrives at the site of work. The valance will be paid on acceptance of the tested, completed bridge.

# SECTION XV

## MISCELLANEOUS EQUIPMENT

15-01. GENERAL. - The lock shall be provided with two lock unwatering pumps and three sump pumps as indicated on the drawings.

15-02. MATERIALS AND WORKMANSHIP. - All materials and workmanship shall be in conformity with the requirements of Sections Vl, Vll, Vlll, and XVl, wherever applicable.

15-03. LOCK UNWATERING PUMPS AND SUMP PUMPS.

(a) General. - The contractor shall design, construct, furnish and install two lock unwatering pumps and three sumps complete with all necessary accessories as indicated on the drawings or specified herein.

(b) Each unwatering pump shall be designed for a capacity of 9000 g. p. m. at 50 foot head, centrifugal, vertical shaft type with electric motor above. The accessories to be furnished with each pump shall include the necessary intake and discharge pipe, shafts and bearings, two gate valves, and two check valves, installed as shown on the drawings.

(c) Each sump pump shall be designed for a capacity of 200 g.p.m. at 50 foot head, centrifugal, vertical shaft type with electric motor above, equipped with float switch and automatic starter. The accessories to be furnished with each pump shall include the necessary intake and discharge pipe shafts and bearings, one gate valve and one check valve installed in the discharge pipe.

(d) Payment. - Payment for the two lock unwatering pumps and the three sump pumps, including intake and discharge pipes, shafts and bearings, gate valves, check valves, float switches, starters and other accessories and painting, will be made at the lump sum contract price for "Lock Unwatering Pumps and Sump Pumps."

## SECTION XVI - PAINTS AND PAINTING

16-01. GENERAL. The requirements set forth in this section include both shop and field cleaning and painting. Unless otherwise specified or authorized, all paint materials shall conform to the current Federal Specifications wherever applicable. Where Federal Specifications are not applicable, material shall be as specified, or otherwise subject to the approval of the contracting officer. All colors shall be as specified or subject to the approval of the contracting officer. All paint, when applied, shall provide a satisfactory film and a smooth even surface, except when sand reinforced, and under-coats shall dry without excessive gloss, suitable for the proper application and adhesion of subsequent coats, as approved by the contracting officer. Where necessary, in the opinion of the contracting officer, to suit the conditions of surface, temperature, and weather existing at the particular time of application, the packaged paint may be thinned by the addition of not more than one pint per gallon of mineral spirits (paragraph 16-10(a)) immediately prior to application, provided that in no case shall the viscosity of the paint be reduced to a point where the specified maximum coverages will be exceeded. To distinguish several paint coats of the same color the contracting officer may require the addition of carbon black to give each coat a different shade.

16-02. SURFACE CLEANING AND PREPARATION.

(a) Shop Cleaning. - All surfaces of sector gates shall be thoroughly cleaned of all millscale and other foreign substances to base metal, by sandblasting or any other method approved by the contracting officer. All other exposed metal surfaces to be painted shall be thoroughly cleaned of all loose millscale and other foreign material by wire brushing and/or flame cleaning.

(b) Field Cleaning. - All painted ferrous surfaces of sector gates shall be cleaned of all paint, rust, dirt, and other foreign matter by sandblasting. All other shop primed surfaces shall be cleaned of dirt, oil, or other foreign substances by the use of mineral spirits or other approved cleaning agents, immediately prior to the application of field coats, and all blisters and breaks in the paint film shall be cleaned to base surface by wire brush or scraper.

(c) Protection of Surfaces. - Care shall be taken to adequately protect all machinery parts, threads, and finished surfaces during cleaning and preparation.

(d) Inhibition. - No shop inhibitive treatment will be required. All surfaces cleaned in the field by sandblasting, or equally effective method, shall be treated with a chemical rust inhibitor (paragraph 18-07). The inhibitor shall be applied as soon after cleaning as practicable, and prior to formation of any forms of corrosion from atmospheric moisture, or other causes. The inhibitor shall be applied by brush and permitted to dry. This chemical inhibitor however, shall be applied only under conditions such that the temperature of the surfaces to which applied and the air in contact therewith, are between 50 degrees F. and 110 degrees F., in order to insure proper chemical reaction with the metal. After drying, any unneutralized reactive residue on the surfaces shall be removed by thorough wiping with wet cloths. The inhibited surfaces shall then be permitted to dry thoroughly and shall be brushed with a broom to remove the dry duty reaction product, after which a standard priming coat of paint, as indicated, shall be applied as soon as practicable, but in any event prior to deterioration or destruction of the inhibited surface. Should the inhibited surface be damaged or destroyed at any point by any means whatsoever, the surfaces shall be cleaned and re-treated in approved manner prior to application of the paint.

16-03. PAINT APPLICATION.

(a) All painting shall be done in a neat, thorough, and workmanlike manner. Except where otherwise specified or specifically directed, all paint coats shall be applied by either brush or spray in such manner as to produce an even coating of uniform thickness completely coating all corners and crevices. All painting shall be done by thoroughly experienced workmen. Care shall be exercised during spraying to hold the nozzle sufficiently close to the surfaces being painted to avoid excessive evaporation of the volatile constituents and loss of material into the air. Paint shall be applied only to surfaces that are thoroughly dry and only under such combination of humidity and temperatures of the atmosphere and surfaces to be painted as will cause evaporation rather than condensation. A practical test is to wipe a damp cloth on the surface to be painted. If the moist streak dries promptly, conditions conducive to evaporation prevail. In no case shall any paint be applied to surfaces upon which there is frost or moisture condensation, or during rainy or misty weather, without suitable protection as approved by the contracting officer. Painting during unfavorable weather conditions shall be carried on under a protective covering erected for this purpose. While any painting is being done, the temperature of the surfaces to be painted and of the atmosphere in contact therewith shall be maintained at or above 50 degrees F. All paint when applied shall be approximately (within fifteen degrees of) the same temperature as that of the surface on which it is applied. Where protection is provided for paint-surfaces, such protection shall be preserved in place until the paint film has properly dried and removal of the protection authorized by the contracting officer. Items which have been painted shall not be handled, worked-on or otherwise disturbed until the paint coat is completely dry and hard. After delivery at the site of permanent erection or installation, all shop-primed metal work shall be kept clean and free from corrosion. The surfaces shall be repainted or retouched from time to time, when in the opinion of the inspector it becomes necessary, using the same type of paint as the priming coat. Where field-painting at the site has been commenced on any portion of the work, the complete painting operation, including priming and finishing coats, on that portion of the work, shall be completed within 30 days after the date of such commencement. All coats on all painted surfaces shall be unscarred at the time of application of all succeeding coats, and when in the opinion of the contracting officer it becomes necessary, all coats shall be maintained by retouching or repainting, using the proper paints for the respective coats. After completion of painting, all glass, woodwork, and hardware and other surfaces not required to be painted shall be cleaned to the satisfaction of the contracting officer.

(b) Coverage. - The surface area covered per gallon for each type of paint specified shall be not greater than the following:
On smooth metallic surfaces:

| | | |
|---|---|---|
| 1st Priming Coat - - - | 600 | Sq. Ft. |
| 2nd " " | 425 | " " |
| 1st & 2nd Finish Coats | 550 | " " |

On sanded priming coat:

Sanded Primer Coat - - - - - - - - 424 Sq. Ft.
1st Finish Coat - - - - - - - - - 250 " "
2nd Finish Coat - - - - - - - - 300 " "
3rd Finish Coat - - - - - - - - - 400 " "

16-04. PRIMING COATS.

(a) Unpainted Surfaces.- The surfaces of all ferrous metal work to be embedded in the concrete, machined surfaces, surfaces requiring weldings, and surfaces which will be in riveted contact shall not be painted unless otherwise specified.

(b) Shop Priming.

(1) Unless otherwise specified all exposed ferrous metal shall receive one shop coat of Synthetic Red Lead Primer.

(2) Machinery and mechanical equipment (except threads and finished surfaces) subject to exterior atmospheric exposure, shall receive one shop coat of Synthetic Red Lead Primer.

(3) Interior machinery, mechanical and electrical equipment shall receive at least one priming coat of an approved synthetic-varnish paint compatible with the synthetic enamel approved for finish coats.

(4) Machined surfaces shall, immediately after final inspection be thoroughly cleaned of all foreign matter and coated with Rust Preventive Compound, U. S. Army Specification 2-84A.

(5) Screw threads shall be protected by a coating of heavy oil.

(c) Field Priming.

(1) All ferrous surfaces of sector gates shall be treated as follows: After cleaning by sandblasting, the surfaces shall be inhibited and painted with one coat of Synthetic Red Lead Primer. In this coat, a heavy uniform cource of perfectly clean sand (see paragraph 16-11 (f)) shall be thoroughly and uniformly embedded within 15 minutes after application of the paint, or in any event before the paint has set to such extent as to prevent the proper embeddment and adhesion of the sand particles. The sand shall be applied by air spray at reduced pressure or in any other manner which will insure thorough embeddment of the maximum volume of sand particles without appreciable movement of the paint film. This coating shall be allowed to dry for a minimum of 48 hours prior to application of finish coats.

(2) All other surfaces shall receive a second priming coat of Synthetic Red Lead Primer after final erection in place in the structure. Surfaces which will be inaccessible after erection shall be painted prior thereto.

16-05. FINISH COATS.

(a) General. - Unless otherwise specified, or authorized, the sand reinforced printed metal shall be given three coats of Gray Finish Enamel (See paragraph 16-06 (d)). Exposed primed surfaces of all other metal work shall receive 2 coats of Gray Finish Enamel. The priming coat over which it is applied shall be thoroughly dry and hardened, and at least a 24-hour interval shall be allowed between two successive finish coats and not less than 5 days for hardening of the final coat before being submerged in water. In any case, all finish painting shall be completed within 30 days after application of the first field-priming coat.

(b) Interior Mechanical and Electrical Equipment and parts for installation within buildings, and not subject to either water or atmospheric exposure, shall, unless otherwise specified or authorized, receive two coats of Heat Resistant Primer and Finish-Metal, except that parts not subject to temperature in excess of 150 degrees F. may be given two coats of a high quality synthetic resin enamel, similar and equal to "Lustrlife" Enamel as manufactured by the St. Louis Surfaceer and Paint Company, St. Louis, Missouri.

### 16-06. PAINTS AND PAINT FORMULAE.

(a) General. - Paints shall have the composition as indicated below and shall be of a color matching the color clips attached or as otherwise approved by the contracting officer. All paints shall be guaranteed by the manufacturer not to gell, liver or thicken deleteriously or form gas in a closed container within a period of one year from date of manufacture.

(b) Processing of Paints.

(1) Except where otherwise specified or authorized, all paint shall be made by grinding together dry or paste pigments and a liquid vehicle to form a smooth paint that will flow freely and will not settle or react deleteriously in containers.

(2) Grinding shall produce a fineness such that coarse particles and skins will not exceed 1.5 percent (total residue left on No. 325 mesh screen, based on pigment). The grinding shall be done in a roll or pebble mill at temperatures that will not cause polymerization.

(3) Skinning shall be negligible after exposing 6 ounces of paint in a tightly closed 8 ounce glass container to sunlight for a total time of 24 hours.

(4) The resulting paint shall have satisfactory brushing and leveling properties, shall set to touch in not less that one hour nor more than four hours, unless otherwise specified, and shall provide a satisfactory film and a smooth even surface without undue gloss, suitable for proper application and adhesion of subsequent paint coats, as approved by the contracting officer. Sufficient suitable driers shall be added to make the paint dry hard within 18 hours.

(5) In view of potential variations resulting from variable processing equipment and technique, the manufacturer may be allowed, where necessary to produce the specified viscosities, to make slight changes in formula proportions, subject to specific approval of the contracting officer.

(c) Synthetic Red Lead Primer, to be used under all gray enamel finish coats shall be composed of materials conforming, where applicable, to the specified requirements and mixed in the proportions as follows.

| | |
|---|---|
| Red Lead - - - - - - - - - - | 16.5% by weight |
| Iron Oxide - - - - - - - - - | 38.2% |
| Zinc Yellow - - - - - - - | 5.5% |
| Diatomaceous Silica - - - | 6.0% |
| Vehicle (See par. 16-08) | 28.0% |
| Thinner - - - - - - - - - | 5.8% |

The paint shall have a consistency of flow of between 25 and 40 seconds through the 0.15 inch diameter orifice of a standard consistency cup when tested in accordance with the procedure specified in paragraph 9 and 10 of A.S.T.M., Specification D 333-37 for "Methods of Testing Nitrocellulose Clear Lacquers and Lacquer Enamels". It shall have satisfactory brushing and leveling properties, shall set to light touch in not less than 2 hours nor more than 5 hours, and shall dry hard for recoating in not more than 18 hours, when tested in accordance with paragraph P-2d of Federal Specification TT-V 81a, entitled "Varnish; Mixing (for) Aluminum Paint". The vehicle shall be a synthetic resin varnish consisting of a phenol formaldehyde resin with the necessary oils and volatile thinners to produce elasticity, water-proofness, adherence, and durability in the finished paint film. It shall meet the detailed requirements of paragraph 16-08.

(d) Gray Finish Enamel. - Unless otherwise specified, all finish paint for all metal surfaces shall have the following composition and properties:

Coloring pigments - - - - - - - - - - 0.5 lbs. (approx.)
Lead Titanate - - - - - - - - - - - - - 3.0 lbs.
Magnesium silicate - - - - - - - - - 1.0 lbs.
Acicular Zinc Oxide - - - - - - - - - 0.25 lbs.
Vehicle (See par. 16-08) - - - - - 1.0 gallon

The paint shall have a consistency of flow of between 18 and 40 seconds through the 0.15 inch diameter orifice of a standard A.S.T.M. consistency cup. The enamel shall have good self leveling properties and when brushed or sprayed on a vertical surface at a coverage rate of 500 square feet per gallon shall dry hard and elastic without running, streaking or sagging.

(e) Gray Heat Resistant Primer and Finish Paint for Metal shall have the following composition:

Coloring Pigments - - - - - - 1.0 pound (approx.)
Titanium Dioxide - - - - - - 3.0 pound
Vehicle - - - - - - - - - - - - 1.0 gallon

Driers - sufficient approved driers to make the paint dry hard in 10 hours.

The vehicle shall be a glycerol-phthalate resin varnish of the following composition:

Glycerol-Phthalate Resin Solution - - 3/4 gallon
Mineral Spirits - - - - - - - - - - - - 1/4 gallon

The glycerol-phthalate resin solution shall consist of 70 percent by weight of glycerol-phthalate resin dissolved in 30 percent by weight of xylol and shall be similar and equal to "Rezyl" No. 110, Solution No. "C" as manufactured by the American Cyanamide & Chemical Corporation, 30 Rockefeller Plaza, New York, N. Y.

16-07. CHEMICAL RUST INHIBITOR, to be used where specified or required, shall be an approved compound of water, a wetting agent, a viscosity agent, phosphoric acid, and sodium dichromate. The concentration of the solution at the time of application shall be such that the Orthophosphoric acid ($H_3PO_4$) content shall be between 7.0 and 9.0 percent (by weight) and the Sodium Dichromate approximately 0.75 percent. Commercial rust inhibitors of composition somewhat different from this may be acceptable in lieu thereof, subject to approval by the contracting officer of results of approved tests showing that the inhibiter, when applied in accordance with instructions of the manufacturer, will identically affect ferrous surfaces as the specified compound in the following ways:

(a) Chemically react with rust and surface metal to etch the surface, form a dull grayish coating of iron-chromate-phosphate, and produce a rust-inhibited surface receptive to the firm bonding of the priming paint.

(b) After initially being thoroughly dried, the inhibited surface shall show no deleterious rusting when subject to light rain or to other dampening agency for a period of not less than 4 hours.

(c) Leave no unneutralized active chemicals on the surface.

16-08. PHENOLIC RESIN VARNISH VEHICLE shall conform to the following requirements:

(a) Oil-resin ratio shall be 33 gallons of oil to 100 pounds of resin.

(b) Shall be clear and transparent and entirely free from resin, estergum or other non-phenolic resins. Not less than 50 percent by weight of the vehicle shall consist of non-volatile oil and resin.

(c) The resin content shall be 100 percent para phenyl phenol-formaldehyde condensate similar and equal to Bakelit BR 254, and shall conform to the current U. S. Navy Department Specification 52R10 entitled "Resin Phenol-Formaldehyde."

(d) The volatile thinner shall contain not more than 80 percent mineral spirits and not less than 20 percent high flash coal tar naphtha or high flash hydrogenated petroleum naphtha and shall be free from toxic hydrocarbons such as benzol.

(e) The oil content shall be a ternary oil mixture composed of 40% linseed, 30% liquid oiticica, and 30% "dehydrated" castor oil.

(f) The flash point shall be not below 30 degrees C. in a closed cup tester.

(g) Shall pass a Kauri Reduction Test of 120 percent, using the method described in paragraph F-2g, Federal Specification TT-V-81 for "Varnish; Mixing (for) Aluminum Paint."

(h) Shall show no skinning after 48 hours in a 3/4 filled, tight container.

(i) Flow-out films on tin plate panels dried 72 hours shall withstand immersion in cold water for 96 hours, and in distilled water at 200 degrees F. for 7 hours without showing more than a slight haze which shall disappear within one hour, and shall show no other signs of deterioration. The panel shall be allowed to dry and cool for 15 minutes after removal from hot water and shall then be inspected for signs of failure.

16-09. PIGMENTS

(a) Carbon Black shall conform to either Federal Specification TT-B-601, entitled "Boneblack; Dry, Paste-in-Japan, Paste-in-Oil" or Federal Specification TT-L-71 entitled "Lampblack; Dry, Paste-in-Japan, Paste-in-oil."

(b) Lead Titanate shall be similar and equal to Titanox "L" as manufactured by the Titanium Pigment Corporation.

(c) Red Lead shall conform to Federal Specification TT-R-191a

(97) percent Grade for "Red Lead; Dry and Paste-in-Oil."

(d) Iron Oxide shall contain not less than 98 percent $Fe_2O_3$ and shall not contain any organic coloring matter.

(e) Diatomaceous Silica shall be an approved commercial grade.

(f) Zinc Yellow shall contain not less than 40 percent $CrO_3$. It shall be a basic zinc potassium chromate, soluble in acetic acid, free from lead compounds, and containing no added zinc oxide, and shall be stable or non-reactive with the pigments and vehicles specified.

(g) Titanium Dioxide shall be similar and equal to either "Ti-Pure O" as manufactured by Krebs Pigment & Color Corporation or "Titanox NC" as manufactured by the Titanium Pigment Corporation.

### 16-10. THINNERS AND SOLVENTS.

(a) Mineral Spirits shall have the following properties:

| | |
|---|---|
| Gravity | 43-37 degrees Baume |
| Flash Point (Closed cup) | 100 degrees F. Min. |
| Initial Boiling Point | 300-310 degrees F. |
| End Point | 405 degrees F. Max. |
| A.S.T.M. Copper Strip Test | Negative |
| Solvency (Kauri-Butanol) | 41 cc(a) 77 degrees F. Min. |

(b) Dipentine shall have the following properties:

| | Maximum | Minimum |
|---|---|---|
| Specific Gravity at 15.5°C. | 0.854 | 0.845 |
| Refractive Index at 20 °C. | 1.477 | 1.472 |
| Unpolymerized Residue (percent $38N_2H_4SO$) | 2.5 | |
| A.S.T.M. Distillation Range: | | |
| 5% Distilling at | 173 degrees C. | |
| 10% Distilling at | 175 degrees C. | |
| 97% Distilling at | 188 degrees C. | |
| Color-Lovibond 500 Amber | 3 | |

Appearance: Clear and free from suspended matter.

(c) Toluol shall conform to U. S. Navy Department Specification 52T7 entitled "Toluene (Tulouol), " except that it shall have a solvency (Kauri-Butanol Method) of not less than 100 cc. at 77° F.

(d) Xylol shall conform to A.S.T.M. Specification D364-36 for "Industrial Xylene (Xylol) or "Solvent Naphtha", except that it shall have a solvency (Kauri-Butanol Method) of not less than 93 cc. at 77°F.

(e) Normal Butyl Alcohol (Butanol) shall conform to A.S.T.M. Specification D304-33 for "Butanol (Normal Butyl Alcohol)."

(f) Ethylene Glycol Monoethyl Ether shall conform to A.S.T.M. Specification D331-35 for "Ethylene Glycol Monoethyl Ether."

### 16-11. MISCELLANEOUS MATERIALS.

(a) Oil, Linseed JJJ-O-331 for "Oil; Linseed, Boiled," or JJJ-O-336, for "Oil; Linseed, Raw," as specified or required.

(b) Insulating Varnish, U. S. Navy Department Specification 52-V-13b, entitled "Varnish; Insulating, (for) Electrical Purposes."

(c) Creosote Paint for surface treatment of timber shall conform to Federal Specification TT-W-561a, entitled "Wood Preservative, Creosote (for) Brush and Spray Treatment."

(d) Ortho-Phosphoric Acid ($H_3PO_4$), shall be a commercially pure product, in liquid form, containing not less than 75 percent $H_3PO_4$.

(e) Sodium Dichromate, ($Na_2Cr_2O_7$), shall be a commercially pure product in crystalline form containing not less than 85 percent $Na_2Cr_2O_7$.

(f) Sand shall be perfectly clean, dry, de-dusted, silica sand particles, graded so that not more than 5% will be retained on a No. 30 mesh sieve and not more than 5% will pass a No. 50 mesh sieve, and shall be obtained by a wet-washing process.

16-12. INSPECTION.

(a) Unless otherwise specifically authorized, inspection of all materials for the paints and chemical rust inhibitor and the manufacture thereof, will be made by a representative of the contracting officer. All samples of materials and of the finished processed products will be tested and analyzed for conformity with the specifications by the Government. The inspector will collect for testing, samples of each of the materials to be used in the manufacturing processes and will then seal the material containers until test results from the samples indicate that the various materials conform to specifications. He will witness the breaking of the seals on the approved material containers and the compounding of the materials for the product being manufactured, will collect samples of the finished product for testing, and will witness the placing, sealing, and the labeling of the finished product in containers for shipment. After the finished products have successfully passed the prescribed test, shipment of the sealed containers will be authorized.

(b) In the case of ready-mixed and packaged paints of standard manufacture, other than those specified by trade name, the contractor shall furnish a sample in the standard stock package, together with a certified copy of the complete chemical analysis, for test and approval by the contracting officer.

16-13. PAINT FOR MAINTENANCE. - To insure that paint used for maintenance after completion of the work shall match the original, the contractor shall furnish to the Government not less than one gallon and not more than ten gallons of each color used. The quantity of each color furnished shall be determined by the contracting officer from consideration of the severity of usage to which the surface on which it is applied is likely to be subjected.

16-14. PAYMENT for all paint and painting will be included in the contract price for the respective metals or items painted.

## SECTION XVII - HIGHWAY

### 17-01. GENERAL.

(a) Permanent Highways. - The contractor shall construct a permanent highway as shown on the drawings. The permanent highway shall extend from a point on an existing road about 3500 ft. southeast of the lock up to and along the crest of the South Dike, across the bridge over the lock, thence along the crest of the North Dike to connect with an existing road at a point about 2300 ft. northwest of the lock.

(b) Removal of Temporary Facilities. - After completion of the permanent highway across the lock and dikes, including proper connections with the existing road at each end, the plug left across the lower approach channel as shown on the drawings, shall be removed to the indicated lines and grades, in accordance with Section II. Payment will be made at the contract price per cubic yard for "Excavation, Common".

(c) Use and Maintenance of Highway. - Other contractors shall have the privilege of using any portion of the highway which has been completed under this contract. The contractor shall maintain in serviceable condition during the life of the contract the highway built by him, to the satisfaction of the contracting officer. No separate payment will be made for such maintenance.

### 17-02. FORMATION OF ROADBEDS.

(a) Alignment. - The center of roadbed for the permanent highway specified in paragraph 17-01, shall conform in alignment to that shown on the drawings .

(b) Grade Line. - The grade line for the highway indicates the top of the finished roadway surface.

(c) Width of Roadbed. - When properly compacted and finished, the roadbed shall conform to the dimensions shown on the drawings.

17-03. CLEARING AND GRUBBING. - Clearing and grubbing shall conform to paragraph 2-01, and no separate payment will be made, therefore.

17-04. EXCAVATION AND EMBANKMENT. - Excavation and embankment construction shall conform to Sections II and III. Payment will be made at the respective contract unit prices for the various items of work required.

17-05. DITCHES. - Ditches shall be excavated on the uphill side and above all excavations where the original ground slopes toward the roadway, and elsewhere as indicated on the drawings or ordered by the contracting officer. Intercepting ditches shall also be constructed at the foot of all embankments where deemed necessary and to the waterway which is provided to take the drainage under the roadway. Where directed by the contracting officer intercepting ditches shall be excavated in advance of roadway excavation and embankment placing. Material excavated from intercepting ditches shall be placed on the downhill side of the ditch and shall be neatly formed and sloped to an embankment section as directed by the contracting officer. Payment will be made at the contract unit price per cubic yard for "Excavation, Common".

17-06. SUPERELEVATION. - Highway widening and superelevation shall be as indicated on the drawings.

17-07 . GRAVEL FILL BASE. - Material for gravel fill bases where indicated on the drawings shall be run-of-bank sand and gravel passing a 4 inch mesh screen as approved by the contracting officer. Gravel containing an excess of clay, silt or other unsuitable materials as determined by the contracting officer shall not be used. Embankments shall be constructed to final dimensions and grades free from ruts and depressions prior to the placing of gravel. Placing and compaction of the gravel base shall be done in accordance with the specifications of the State of New York, Divisions of Highways, Item 39 - "Foundation Coarse-Run-of-Bank Gravel". Payment will be made at the contract unit price per cubic yard for "Gravel Fill Base", measured to the lines indicated on the drawings.

17-08. CULVERTS

(a) The contractor shall furnish all materials, labor and equipment required for installing corrugated iron drainage culverts conforming to paragraph 6-09, as indicated on the drawings. The lengths of culverts shall be as directedby the contracting officer.

(b) Payment for culverts will be made at the contract price per linear foot for "Pipe, Corrugated Iron, 24 inch diameter".

17-09. BITUMINOUS MACADAM ROAD SURFACING.

(a) General. On top of the 9 inch gravel base, paragraph 17-07, the bottom course of the roadway surfacing shall be a 4 inch bituminous macadam penetration course, and the top course 2 inches plant mix bituminous macadam.

(b) Bottom Course. The bottom course bituminous macadam shall be 4 inches thick after compaction androlling. The materials, methods of work, surface testing, and other items shall conform to the specifications of the State of New York, Division of Highways, Item 45 - S - Bottom Course Bituminous Macadam - Penetration Method. The asphalt shall conform to Item 64P-A and the amount used shall be two gallons per square or as ordered by the contracting officer.

(c) Top Course. The top course bituminous macadam shall be 2 inches thick after compaction and rolling. The materials, method of work, surface testing, and other items shall conform to the specifications of the State of New York, Division of Highways, Item 53 - Top Course Bituminous Macadam - Mixing Method, Type 3.

(d) Payment. Payment for the bottom andtop course of road surfacing will be made at the contract unit price per square yard for "Road Surfacing" which payment shall include all materials, plant, and labor necessary for completion of the roadway in accordance with the drawings.

17-10. HIGHWAY GUARD RAIL.

(a) General. A two wire guard rail shall be installed on both sides of all embankments greater than 5 feet in height and elsewhere as directed by the contracting officer. Posts shall be 8 inch fir, sound and free from defects. All posts shall be pressure creosote treated for the full length in accordance with the requirements of Federal Specification TT-W-571a for "Wood-Preservative; Preservative-Treatment" as shown in Table I for empty-cell treatment of structural timber for the size and material indicated. Creosote shall conform to Federal Specification TT-W-566. All holes shall be drilled before creosoting. Wire rope shall conform to Federal Specification RR-R-571, amendment 4, dated January 1941, for "Rope, Wire", for Type III, 3 by 7, annealed steel, galvanized wire rope. Anchor cords, clamp bolts, and all metal parts and fitting shall be galvanized iron. The posts shall be set plumb, evenly spaced, and true to lines andgrades as indicated on the drawings. The wire shall be put through hook bolts, or through posts as required, and shall be drawn taut and fastened securely on both ends as indicated. Where necessary, cable shall be neatly and carefully spliced or joined by means of metal sockets into which the cable's ends are securely fastened by pouring full of molten zinc. Deadman type anchors shall be provided at the ends, and at intervals of 600 feet as indicated on the drawings.

(b) Payment. - Payment for furnishing and installing of guard rail, complete, will be made at the contract unit price per lineal foot for "Highway Guard Rail." Measurement will be made from center to center of end posts plus an allowance of 15 feet for each anchorage.

17-11. SEEDING. - Seeding of any slopes asrequired by the contracting officer shall meet the requirements of paragraph 3-09.

## SECTION XVIII - GOVERNMENT FIELD OFFICE

18-01. GENERAL. - The contractor shall construct a temporary field office for use by the field force of the contracting officer, complete and ready for occupancy in accordance with the drawings and specifications. The contractor shall complete the field office to such extent as will permit occupancy within 30 calendar days after date of receipt of notice to proceed and the entire building complete with all fixtures and installations shall be completed within 60 calendar days after receipt of notice to proceed. The building will be located at a site to be selected by the contracting officer after award of the contract. It is the intent of the Government to locate the building in the proximity of the contractor's office and shops at the site of the work. All materials specified shall conform in all respects to current Federal Specifications whenever applicable. All other materials shall be as specified or otherwise required by the contracting officer.

18-02. FEDERAL SPECIFICATIONS. - Applicable Federal Specifications for material required for the field office are as follows:

FEDERAL SPECIFICATIONS

| Material | Serial Number | Title |
|---|---|---|
| Cable and Wire | J-C-106a | Cable and Wire: Rubber-Insualted, Building-Type Heat-Resistant grade (0 to 5,000-volt service) |
| Galvanized Iron | QQ-1-696 | Iron and Steel; Sheet, Black and Zinc-Coated (Galvanized) |
| Galvanized Pipe | WW-P-403a | Pipe; Steel and Ferrous-Alloy, Wrought, Iron-Pipe-Size |
| Glass | DD-G-451 | Glass; Flat (for) Glazing Purposes |
| Lumber | MM-L-751b | Lumber and Timber; Soft-wood |
| Magnesia | HH-M-61 | Magnesia; Block, Cement, and Pipe Covering (Molded) |
| Pipe - Soil | WW-P-401 | Pipe and Pipe-Fittings; Soil, Cast-Iron |
| Pipe-Fittings | WW-P-501a | Pipe - Fittings; Cast-iron (threaded) |
| " " | WW-P-521a | Pipe - Fittings; Malleable Iron (threaded) |
| Roofing | SS-R-511 | Roofing; Asphalt and Asbestos-Prepared, Mineral-Surfaced |

| Material | Serial Number | Title |
|---|---|---|
| Plumbing | WW-P-541a | Plumbing - Fixtures; (for) land use |
| Putty | TT-791a | Putty; Pure-Linseed Oil, (for) Wood-Sash Glazing |
| Venetian Blinds | LLL-B-441 | Blinds; Venetian, Wood Slat (Type I) |
| Sheathing Paper | UU-P-536 | Paper; Sheathing, Waterproof |
| Wall Board | SS-W-51a & Amendment 1 dated October 1937 | Wall-Board; Gypsum |
| Wire Mesh | QQ-B-101c | Bases, Metal; (for) Plaster and Stucco Construction |

### 18-03. EXCAVATION, FILLING AND GRADING

(a) The contractor shall make the necessary excavation for the parking lot area, foundation, footings, fuel tank, septic tank, pipings and drains as shown on the drawings. The contractor shall remove all necessary rock and other obstructions, grade and cover with 4 inches of rolled bank run gravel fill, a parking space large enough to accomodate 15 automobiles; provide suitable gravel surfaced driveways from the parkway area to the contractor's access road; gravelled walkways necessary for access from office to parking area and roadways in the vicinity. All walkways will be covered with 2 inches of rolled bank run gravel fill, built to line and grade as staked in the field.

(b) Furnace Room. - The foundation area covered by the furnace room shall be stripped to a depth sufficient to remove all vegetable matter, then refilled and tamped with previous material as directed by the contracting officer to a grade 4 inches below the floor grade as shown on the drawings.

18-04. FOUNDATION. - The foundation and footings shall be of Class "B" concrete, having 1-1/2 inch maximum size aggregate, in accordance with Section V of these specifications, constructed to line and grade as shown on the drawings. The foundation posts shall rest on the footings and after being set to exact line and grade shall be anchored into place by backfill thoroughly tamped in thin layers to the height of finished grade as shown on the drawings. The girders supported on top of the posts and foundation shall be securely anchored thereto by bolting as shown on the drawings. Bolts in the foundation will be placed during concreting operations.

18-05. CONCRETE FLOORS. - The floor in the furnace room shall be of Class "A" concrete, in accordance with Section V of these specifications, 4 inches thick, trowelled level, smooth and to a straight edge, or as specified. The furnace room floor shall have floor drain and trap located as shown on drawings, set 1 inch below floor grade and the floor trowelled smooth and to a straight edge from the drain to floor grade at each side. Subfloor construction shall be as shown on the drawings. Reinforcing for concrete floors shall be 4-inch by 12-inch welded wire fabric of No. 10and No. 12 wire gage.

18-06. FRAMING. - Lumber for framing shall be equal to No. 2 common fir. It shall be throughly seasoned, straight, even sawed, square cornered, sound and free from defects which may impair its strength, durability or its usefulness, for the purpose intended. All lumber shall be of commercial sizes, surfaced four sides unless shown or specified otherwise. The framework shall be constructed as indicated on the drawings and shall be erected in a substantial manner. Studding shall not be spaced over 16 inches on centers for exterior walls and not over 24 inches on centers for interior walls, doubled at all openings larger than the normal spacings and when cutting through joists, or rafters headers shall be provided to double the framing around the openings. Double studs shall be provided at all corners of the building. Knee braces shall be provided from the corner studs to the fifth stud, diagonally from bottom plate to top plates at all corners of the building. Ridge board shall be provided at the ridge of the roof. All spiking of assembled members of framing shall be clinched by not less than ¼-inch. Rafters and ceiling joists shall be spaced at 24-inch centers or as shown on drawing.

18-07. FLOORS. - Flooring shall be 1-inch by 4-inch tongue-and-groove clear edge grain, kiln dried, B grade fir or equal, and shall be driven up tight, blind nailed and sanded. Before laying the flooring a layer of water proof building paper shall be stretched over the top of the joists and tacked in place. All flooring shall be staisfactorily protected from dampness and the weather before being placed. Floor joists shall be spaced on 16-inch centers.

18-08. SIDING.- The outside faces of the building shall be covered with 25/32" asphalt-covered fibre sheathing nailed securely to every 2" x 4" stud with 8d flat-headed wire nails. The outside siding is to be formed of asbestos shingles laid according to best current practice with backing strips at each vertical seam.

A 20 gage galvanized iron flashing shall be run continously along the sill of the building and buried at least 12 inches below the finished ground line. All seams shall be soldered.

18-09. ROOFING. - Roof sheathing shall consist of 1-inch by 6-inch No. 2 fir or equal, dressed and matched on both sides with no beading. The roofing shall be double-coated strip shingle similar or equal to "Flintkote" roofing weighing not less than 210 pounds per square. The roofing shall be securely fastened with large headed, 3/4 inch galvanized roofing nails. All seams, nail holes and other breaks in the roofing shall be thoroughly sealed with an approved mastic roofing cement. The ridge shall be covered by a strip of roofing not less than 12 inches in width, bent over the ridge and securely sealed and nailed on each side. Galvanized iron flashing shall be provided and installed as shown on the drawings or as directed by the contracting officer.

18-10. WALLS AND CEILINGS.

(a) General. - With the exception of the bathroom and furnace room, the inside of all exterior walls, both sides of all interior walls and all ceilings shall be covered with ½-inch insulating board similar and equal to "Celotex" extending from floor to ceiling, securely fastened to all bearings. One-inch quarter round mouldings shall be provided at all corners. The edges of the insulation board shall be beveled at joints.

(b) Furnace Room. - The insulating board for walls and ceilings of furnace room shall be 3/8 inch gypsum board, applied and finished in accordance with subparagraph (a), above.

(c) Walls and Ceiling; Bathroom. - The ceiling shall be covered with ½-inch insulating board, similar or equal to "Celotex." The inside of the exterior wall and all interior walls shall have a covering of pressed wood similar to "Masonite" extending 4'-0" above the floor. Above that point. ½-inch insulating board similar and equal to "Celotex" shall be used. Moulding of 1-inc by 3-inch No. 2 fir, or equal, shall be placed over the joint where the pressed wood and insulation board join. The edges of the insullation board shall be beveled at joints. One-inch quarter round shall be placed at all vertical corners and in horizontal corners along the ceiling.

(d) Shower Stall. - The contractor shall furnish and install a commercial shower stall, complete with fittings, as shown on the drawings, similar and equal to "Marine No. 15," manufactured by the Fiat Metal Manufacturing Company, Chicago, Illinois.

18-11. EXTERIOR TRIM. - Exterior trim shall be equal to No. 2 fir, finshing stock 3/4-inch thick except as otherwise noted. Door and window casings shall be 3/4-inch by 3-1/2 inches wide. All other exterior finish shall be to size as indicated on the drawings. Insulating wool of a quality satisfactory to the contracting officer shall be placed entirely around all window frames and around the jambs and heads of all door frames as shown on drawings.

18-12. INTERIOR WOOD FINISH. - All interior wood finish shall be equal to No. 2 fir finishing stock throughout, 3/4 inch or 13/16-inch thick and of sizes as indicated on the drawings. Water closet stalls be 6 foot-4 inches high finished as shown on the drawings or as directed by t e contracting officer. Over each lavatory a 16-inch by 24-½ inch mirror with white enamel metal frame shall be installed. Instrument cabinets shall be constructed as shown on drawings or as directed by the contracting officer.

18-13. WINDOWS AND FRAMES. - Windows shall be of stock pattern, with a 2'-10" wide by 2'6" high, No. 2 fir, or equal, double hung sash or as shown on the drawings, glazed with clear glass. Windows in bathroom shall be single sash, hinged at bottom to open inward, glazed with clear glass, and fitted with cabinet latches. All frames shall be constructed so as to receive screens or storm windows, and as shown on the drawings. All glass will be as specified in paragraph 20-02.

18-14. DOORS AND FRAMES. - Exterior doors shall be solid construction, equal to No. 2 fir, 1-3/4 inches thick, disigned as shown on the drawings. The upper part shall be of glass equal to that specified in paragraph 20-02 set in place with wooden stops on the inside and securely bradded and puttied outside. Interior doors, unless otherwise specified, shall be 1-3/8 inches thick, equal to No. 2 fir and shall have five cross panels. Standard stock doors of equal quality and size will be acceptable. Doors for water closets shall be 2'-0" x 4'6" frames made up of 3/4" x 3-1/2" framing and covered with pressed wood 1/8" thick similar and equal to "Tempered Presdwood" manufactured by Masonite Corporation. Doors for the instrument cabinet shall be 1'-8"x7'-8" as shown on drawings made up of 1-1/8" x 3" framing and covered with pressed wood 1/8" thick. The interior side of t e furnace room shall be covered with 28 gage galvanized iron as shown on the drawings.

18-15. SCREENS. - All windows and outside doors shall be equipped with screens. Window screen frames shall be constructed of No. 2 fir, or equal, 1-1/8 inches thick with 2-inch side and top rails and 3-½ inch bottom rails, divided at the center horizontally by a 2-inch rail. Screen door frames shall be of same material and construction as specified for windows, but with two horizontal intermediate rails, one at 2-1/2 feet and one at 3.0 feet from bottom. Standard stock screen doors of equal quality and size will be acceptable. All screen wire shall be of 16 mesh to the inch, galvanized, conforming to Federal Specification RR-C-451a for "Cloth; Wire Screen." Type "D", stretches and secured with suitable wood strips, well bradded. Suitable screen shall be placed over the bathroom windows.

18-16. LOUVRES. - Wooden louvres shall be constructed and installed at both ends of the building as shown on the drawings. Removable screens and storm protection panels shall be furnished and installed in louvres, as shown on the drawings.

18-17. VENETIAN BLINDS. - All double hung windows, except in the furnace room, shall be fitted with venetian blinds with rust proof hardware fittings, automatic cord lock stopping device and spiral gear to tilt slats. The wooden slats shall be finished in ivory or cream color and the tape shall harmonize with the finish color of the wood. The blinds shall conform to the requirements of Federal Specification LLL-B441 for "Blinds; Venetian, Wood-Slat" (Type I).

18-18. HARDWARE. - The contractor shall furnish and install all hardware specified below. All hardware shall be accurately and securely installed. At completion, all keys shall be delivered to the contracting officer or his representative properly labeled. All hardware shall be of stock design with sanded brass finish, and shall be of the following types, as specified.

(a) Entrance Doors.

2 sets - 1½ prs. of 3½"x3½" loose pin, butt hinges.
2 cylinder locks with 5½"x3-5/8"x3/4" case.

(b) Interior Doors

6 sets - 1½ prs. of 3½"x3½" loose pin butt hinges.
6 mortise locks with 3-5/8"x3-7/8" case.

All locks shall be complete with two keys and approved knobs, latches, and escutcheons.

(c) Windows.

100 Iron easy spring window bolts and fasteners.
4 prs. 1½"x1½" tight pin, butt hinges.

(Bathroom windows)
2 cabinet latches(Bathroom Windows)

(d) Water Closet Doors

2 latches and keepers
4 pr. spring hinges (for 3/4-inch doors)

(e) Instrument Cabinets.

4 night locks complete
8 pr. cabinet hinges (for 1-1/8-inch doors).

(f) Miscellaneous.

54 screen hangers complete
29 - 3-inch hooks and eyes
4 pr. screen door hinges

The contractor shall furnish and install all other hardware and minor parts that may be necessary to complete the contract.

18-19. PAINTING.

(a) Exterior. - Before applying any paint the surface to be painted shall be thoroughly dry and free from dirt, oil, grease and other foreign substances. As soon as complete the outside surfaces, of windows, doors, and screen frames shall be given one priming coat of paint, conforming to Federal Specification TT-P-362 for "Paints; Lead-Zinc-Base, Ready-Mixed and Semi-paste, White and Tinted." After the priming coat has thoroughly dried, one finishing coat of white outside house paint, shall be applied to all wood surfaces, except the outside trim. All outside trim surfaces shall be painted with one finishing coat of green, medium shade, outside paint as approved. All paint for finishing coats shall be of stock No. 6 B SW ODP White Lead as manufactured by the Sherwin Williams Company, or equal.

(b) Interior. - All interior woodwork, except floors, shall be painted with two coats of inside paint by approved manufacture and color. All finished floors shall be given one heavy coat of boiled linseed oil.

18-20. PLUMBING.

(a) All labor and materials required for installing a complete plumbing system shall be provided as indicated on the drawings and in accordance with these specifications and in accordance with any State or local regulation, and the publication "Recommended Minimum Requirements for Plumbing in Dwellings and Similar Buildings," issued by the Bureau of Standards.

(b) The plumbing fixtures and accessories shall be similar and equal to those designated below, reference being made, for identification only, to catalog numbers as listed in Kohler Co. Catalog K-39:

2 Closets, No. Brooklands K-3940-PR complete with fittings.
2 Toilet paper holders.
2 Lavatories No. Clare K-3000-P with fittings.
1 Floor drain and trap.
1 - 3'0" Urinal - Jarves No. K-5052-A complete with fittings.

(c) The field office shall be supplied with a constant and uninterrupted potable water supply of not less than 35 and not more than 50 pounds per square inch pressure, furnished by the contractor. The supply line shall be 3-inch pipe placed in a trench of sufficient depth and protected to prevent freezing in subzero weather. At the point of entrance, in bathroom, a main shut-off and drain cock shall be installed. Pipe sizes and valves shall be as shown on the drawings. An automatic electric hot water heater of 30-gallon capacity shall be furnished and installed. The heater shall be similar and equal to Westinghouse Electric Manufacturing Company's Square Type Electric water heater, installed to manufacturer's specifications.

(d) The contractor shall lay a 4-inch vitrified pipe cover line from the end of the cast iron soil pipe, outside the building to the sewage disposal tank located not less than 50 feet from the building. Vitrified pipe shall conform to the requirements of Federal Specification SS-P-361 for "Pipe; Clay, Sewer." The sewer shall be laid with ¼ inch to 1-foot pitch, true to line and grade, and made up with tight joints. The sewage disposal tank shall be similar and equal to Kaustine Standard Series Horizontal Septic Tank No. 85, and provided with proper connections for outlet and inlet pipes. The outlet shall connect to a grid system not to exceed 780 feet of 4 inch field tile pipe including connections. The joints of the field tile pipes shall be laid open, ¼-inch, and top half of each joint shall be covered with sheathing paper. If the field office is conveniently located, the sewer line from the Government Field Office may be connected to the sewer disposal system of the contractor's office, provided the system is designed to carry the extra sewage, subject to approval by the contracting officer.

18-21. ELECTRICAL WIRING. - The contractor shall secure all permits and give such notices as required by State and local authorities. The installation shall be in strict accordance with the National Electrical Code. The system shall be 3-wire, 220/110 volt, single phase, solid neutral, rigid metal conduit to fuse cabinet as indicated on drawings. All wiring shall be single-conductor rubber-insulated, braid covered of the size shown or required and conforming to the requirements of Federal Specification J-C-106a, Type RH. The building shall be wired as indicated on the drawings. Three main feeders of not less than No. 8 AWG wire shall be installed in 1-inch conduit. The The ground wire shall be not less than No. 8 AWG. The entrance switch shall be outside type, 3-wire, solid neutral, 2-pole, 30-amp. Fuse cabinet shall be flush type, steel with door and built for 6 circuits, with solid neutral, motor switch. The motor switch shall be of the automatic thermal protection, reset-type. Each circuit shall be fused with 15-amp. fuses, Duplex plug receptacles or convenience outlets shall be 15-amp., 125-volt, with stamped brass plates. At completion, all circuits shall be plainly marked for identification. The contractor shall furnish and erect if first class manner, all fixtures complete with shades and lamps of the wattage indicated, fuses and all other necessary accessories. The fixtures shall be similar and equal to those designated below. Reference is made, for identification only, to catalog numbers as listed in Benjamin Electric Mfg. Co., catalog entitled "Benjamin Sockets for Reflector Fixtures."

SCHEDULE

| Location No. | No. | Type |
|---|---|---|
| Inspector's Office | 2 | 5642 - PUL R.L.M. Dome with canopy and fixture stud. |
| Clerk's Office | 1 | 5642 - PUL R.L.M. Dome with canopy and fixture stud. |
| Furnace Room | 1 | 5423 Shallow Dome with canopy and fixture stud. |
| Bathroom | 1 | 5423 Shallow Dome with canopy and fixture stud. |
| Bedroom | 1 | 5642 - PUL R.L.M. Dome with canopy and fixture stud. |
| Field Engineers Office | 1 | 5642 - PUL R.L.M. Dome with canopy and fixture stud. |
| Drafting Room | 3 | 5642 - PUL R.L.M. Dome with canopy and fixture stud. |
| Platform | 2 | 6821 - Watertight angle with round box. |

The contractor shall do all cuttong and placing of supports necessary in this work.

18-22. HEATING.

(a) General. - The contractor shall furnish and install an oil burning automatic controlled furnace similar and equal to Mueller's No. 55 F. G. Fuel Oil Furnace. The installation and workmanship shall be in strict accordance with the specifications of the manufacturer, rules and regulations of the National Board of Fire Underwriters and local requirements.

(b) Grills, Registers and Ducts. - All grills and registers shall be furnished and installed by the contractor as shown on the drawings or as directed by the contracting officer. Warm air grills shall be provided with independently adjustable, manually controlled vertical fins for deflection of air. Cold air return register shall be plain lattice type, suitable for floor or wall installation and of the size indicated on the drawings. The hot and cold air duct, register and grill system shall be constructed in accordance with manufacturer's specifications, and installed as shown on the drawings or as directed by the contracting officer.

(c) Smoke Pipe and Vent. - The smoke pipe and vent shall be as specified by the manufacturer for furnace used. The smoke pipe from furnace to 2 inches above roof, shall be covered with asbestos air coil pipe covering, 1 inch thick, properly secured to the pipe.

(d) Fuel Tank. - A fuel supply tank of 500 gallons capacity shall be furnished and installed by the contractor. The tank shall be under ground and covered with not less than 2 feet of well tamped backfill. Fuel tank and all piping shall meet all requirements of the National Board of Fire Underwriters.

18-23. FIRE PROTECTION. - The contractor shall furnish and install one frost proof fire hydrant with suitable connections for two 1½ inch fire hoses. The fire hydrant shall be installed not more than 25 feet from the building and shall be supplied with not less than 35 pounds.

18-24. FLAGPOLE. - The contractor shall furnish and erect one flagpole complete with pulley and rope, as shown on drawings. The flagpole shall be constructed of one 12-foot joint of 2½ inch and one 12-foot joint of 2 inch galvanized steel pipe, with an overlap of 1 foot at union securely welded. The flagpole shall be securely fastened to a concrete base as shown on drawings and shall be so attached that bottom bolt can be removed and pole revolved about upper bolt to a horizontal position or as directed by the contracting officer.

18-25. REMOVAL OF BUILDING. - Upon completion and acceptance, the field office will become the property of the United States and will be removed by the Government. No materials or equipment shall be slavaged by the contractor.

18-26. PAYMENT. - Payment for the field office complete, including the furnishing of all labor, plant and materials necessary to complete the building in accordance with these specifications and as shown on the drawings, will be made at the contract lump sum price for "Field Office" upon acceptance of the building by the contracting officer. The contracting officer retains the right to order the contractor to make an extension as indicated on the drawings, with similar construction and equipment as the original building. Payment for the extension, if any, will be made at the lump sum price for "Field Office Extension."

## STANDARD GOVERNMENT FORM OF BID
## (Construction Contract)

______________________

(Place)______________________

(Date)______________________

To: The District Engineer,
U. S. Engineer Office,
Massena, New York.

1. In compliance with your invitation for bids dated______________ ________ and subject to all the conditions thereof, the undersigned,

______________________________________________________________

a corporation organized and existing under the laws of the State of

______________________________________________________________

a partnership consisting of___________________________________

______________________________________________________________

______________________________________________________________

or an individual trading as___________________________________

______________________________________________________________

of the city of________________________________________________

hereby proposes to furnish all plant, labor, and materials and perform all work required for the construction of the Point Rockway Lock, complete, at the locations shown and to the extent indicated, in strict accordance with the specifications, schedules, and drawings, for the consideration of the following prices:

## SCHEDULE OF BID ITEMS

| No. | Quantity | Unit | Designation | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | 3,138,000 | C.Y. | Excavation, Common | | |
| 2 | 450,000 | C.Y. | Excavation, Borrow | | |
| 3 | 516,000 | C.Y. | Excavation, Rock | | |
| 4 | 67,000 | C.Y. | Earth Fill; Compacted, Class "I" | | |
| 5 | 675,000 | C.Y. | Earth Fill; Compacted, Class "II" | | |
| 6 | 21,000 | S.F. | Line Drilling | | |
| 7 | None | C.Y. | Filter | | |
| 8 | 6,900 | C.Y. | Sand and Gravel Backing | | |
| 9 | 19,100 | C.Y. | Riprap; Dumped, Class "A" | | |
| 10 | 29,900 | C.Y. | Riprap; Dumped, Class "B" | | |
| 11 | 1,100 | Lin.Ft. | Drilling;Grout Holes in Concrete | | |
| 12 | 2,400 | Lin.Ft. | Drilling;Grout Holes in Rock 0 to 25 feet | | |
| 13 | 750 | Lin.Ft. | Drilling;Grout Holes in Rock 25 feet or over | | |
| 14 | 1,800 | Lin.Ft. | Drilling; Exploratory Holes in Rock, 0 to 25 feet | | |
| 15 | 400 | Lin.Ft. | Drilling; Exploratory Holes in Rock, 25 to 50 feet | | |
| 16 | 400 | Lin.Ft. | Drilling; Exploratory Holes in Rock, 50 to 100 feet | | |
| 17 | 4,000 | C.F. | Pressure Grouting | | |
| 18 | 300 | C.F. | Sand in Grout | | |
| 19 | 300 | C.F. | Rock Flour in Grout | | |
| 20 | 34.5 | M.F.B.M. | Timber, White Oak | | |

| No | Quantity | Unit | Designation | Unit Price | Amount |
|---|---|---|---|---|---|
| 21 | 15.1 | M.F.B.M. | Timber; Common, (Creosoted) | | |
| 22 | 1,050 | C.Y. | Concrete; Class "A" (Natural sand, crushed stone sand) | | |
| 23 | 271,500 | C.Y. | Concrete; Class "B" (Natural sand, crushed stone sand) | | |
| 24 | 2,416,000 | Pound | Steel; Structural, Sector Gates Movable Parts | | |
| 25 | 6,500 | sq.ft. | Floor Plating; Steel | | |
| 26 | 1,104,000 | Pound | Steel; Structural, Stop Logs | | |
| 27 | 685,000 | Pound | Steel; Structural, Miscellaneous | | |
| 28 | 600,000 | Pound | Steel Erection; Concrete Reinforcement | | |
| 29 | 90,000 | Pound | Forgings; Steel | | |
| 30 | 220,000 | Pound | Castings; Steel | | |
| 31 | 13,000 | Pound | Castings; Alloy Steel (including Nickel) | | |
| 32 | 70,000 | Pound | Castings; Iron | | |
| 33 | 11,000 | Pound | Brass and Bronze | | |
| 34 | None | Pound | Miscellaneous Non-ferrous Metals | | |
| 35 | 2,400 | Lin.Ft. | Pipe; Steel, Black, 12" dia. | | |
| 36 | 700 | Lin.Ft. | Pipe; Steel, Black 6" dia. | | |
| 37 | 400 | Lin.Ft. | Pipe; Steel, Black, 4" dia. | | |
| 38 | 17,000 | Lin.Ft. | Conduit; Fiber 3" dia. | | |
| 39 | 1,400 | Lin.Ft. | Conduit; Rigid Metal, 2" dia. | | |
| 40 | Job | Sum | Electrical Grounding System | | |
| 41 | 2,300 | Lin.Ft. | Handrailing; Steel Pipe | | |
| 42 | 7,200 | Pound | Rubber Seals, Moulded | | |

| No. | Quantity | Unit | Designation | Unit Price | Amount |
|---|---|---|---|---|---|
| 43 | 28,000 | Pound | Corrugated Sheet; Iron | | |
| 44 | 28 | Lin.Ft. | Tile Gages | | |
| 45 | 250 | Each | Core Boxes | | |
| 46 | Job | Sum | Stiff-Leg Derricks and Machinery | | |
| 47 | 25,200 | Pound | Pick-up Boom; 2 at 12,600 lbs. | | |
| 48 | 218,600 | Pound | Machinery;Sector Gates,Furnished and Installed, 8 sets | | |
| 49 | 8 | Set | Motors, Brakes and Limit Switches; for Sector Gates,Furnished & Installed | | |
| 50 | 31,300 | Pound | Fender Boom | | |
| 51 | 511,200 | Pound | Machinery; Wire Rope Fenders Installed only, 4 sets | | |
| 52 | 4 | Set | Motors, Brakes and Limit Switches; for Wire Rope Fenders, Installed only | | |
| 53 | 300 | C.W.T. (100lbs) | Counterweight | | |
| 54 | Job | Sum | Swing Bridge and Machinery; Complete | | |
| 55 | Job | Sum | Lock Unwatering Pumps and Sump Pumps | | |
| 56 | Job | Sum | Field Office | | |
| 57 | Job | Sum | Field Office Extension | | |
| 58 | 7.5 | Acre | Seeding | | |
| 59 | 100,000 | square (100sf) | Rolling for each Additional Two Trips | | |
| 60 | 3,600 | C.Y. | Gravel Fill Base | | |
| 61 | 14,200 | S.Y. | Road Surfacing | | |
| 62 | 3,900 | Lin.Ft. | Highway Guard Rail | | |
| 63 | 40 | Lin.Ft. | Pipe; Corrugated Iron 24"dia. | | |
| 64 | 300 | each | Pressure Test; Grout Holes | | |

NOTES: (a) All amounts and totals given above will be subject to verification by the United States. In case of variation between unit bid price and totals shown by bidder, the unit price will be considered to be his bid.

(b) All bids must be for the entire work and must have each blank space filled in.

(c) The quantities of each item of the bid, as finally ascertained at the close of the contract, in the units given and the unit prices of the several items stated by the bidder in the accepted bid, will determine the total payments to accure under the contract. The unit price bid for each item must allow for all collateral or indirect cost connected with it.

2. EXPERIENCE. (See Invitation for Bids, paragraph 14.)

3. STATEMENT ESTABLISHING PERMANENT PLACE OF BUSINESS AND FINANCIAL STATUS. (See Invitation for Bids)

4. PLANT TO BE USED ON THE WORK. (See Invitation for Bids and paragraph 1-19 of the specifications.

(a) Earth work.

(1) Excavating Equipment

| No. | Type | Manufacturer | Capacity | Age | Condition |
|---|---|---|---|---|---|
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

(2) Transporting Equipment.

| No. | Type | Manufacturer | Capacity | Age | Condition |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

(3) Embankment Equipment.

(a) Spreading and Rolling Equipment.

(b) Pumping and Watering Equipment.

(b) Concrete.

(1) Batching Equipment.

| No. | Type | Manufacturer | Capacity | Age | Condition |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

(2) Transporting Equipment.

(3) Miscellaneous Equipment.

(c) Drilling Equipment.

| No. | Type | Manufacturer | Capacity | Age | Condition |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

(d) Grouting Equipment.

(e) Compressed Air Equipment.

(f) Pumping Equipment.

| No. | Type | Manufacturer | Capacity | Age | Condition |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

(g) Miscellaneous Equipment.

5. PLANT LAY-OUT (See Invitation for Bids). - The undersigned has attached herewith the plant lay-out prescribed in the Invitation for Bids.

6. PROGRESS CHARTS (See Invitation for Bids). - The undersigned has attached herewith the progress charts prescribed in the Invitation for Bids.

7. It is hereby warrented that in the event award is made to the undersigned there will be used in the performance of the work covered by the contract only such unmanufactured articles, marterials, and supplies as have been mined or produced in the United States, and only such manufactured articles, materials, and supplies as have been

manufactured in the United States substantially all from articles, materials, or supplies mined, produced, or manufactured, as the case may be, in the United States except as noted below or otherwise indicated in this bid or authorized in the specifications.

8. The undersigned agrees, upon receipt of written notice of the acceptance of this bid within______days after the date of opening of the bids, to execute the standard form of Government contract, in accordance with the bid as accepted, and give performance and payment bonds, with good and sufficient surety or sureties, for the faithful performance of the contract, and for the protection of all persons supplying labor and materials in theprosecution of the work, within ______days after the prescribed forms are presented for signature.

9. The undersigned agrees to begin the work within ______calendar days after date of receipt of notice to proceed, and complete it within _____calendar days after date of receipt of said notice to proceed.

________________________________
(Bidder)

By______________________________
(Name and Title)

________________________________
(Business Address)

Note: Read Standard Government Instructions to Bidders before preparing this bid.

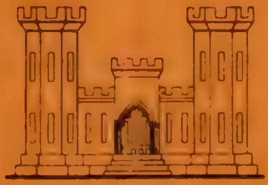
# ST. LAWRENCE RIVER PROJECT

## FINAL REPORT

## 1942

DOCUMENTS Room

# POINT ROCKWAY LOCK
# ANALYSIS OF DESIGN



CORPS OF ENGINEERS, U.S. ARMY

U.S. ENGINEER OFFICE • MASSENA, NEW YORK.

APPENDIX III-8 (3)

# ST. LAWRENCE RIVER

# PROJECT

* * * * *

## FINAL REPORT

## 1942

# POINT ROCKWAY LOCK

## ANALYSIS OF DESIGN

CORPS OF ENGINEERS, U.S. ARMY

U.S. Engineer Office - Massena, New York

July , 1942

APPENDIX III-3 (3)

PART ONE - Point Rockway Lock, Analysis of Design.

PART TWO - Point Rockway Lock, Estimate of Cost.

# PART ONE

# POINT ROCKWAY LOCK

# ANALYSIS OF DESIGN

# ST. LAWRENCE RIVER PROJECT

## POINT ROCKWAY LOCK

## ANALYSIS OF DESIGN

Note

The Analysis of Design for Robinson Bay Lock and Part II of the Analysis of Design for Iroquois Dam are essential supplements to this analysis.

U. S. ENGINEER OFFICE
MASSENA, N. Y.
MARCH, 1942

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## SECTION I - INTRODUCTION

1-01. PURPOSE AND SCOPE. - The general purpose and scope of this report on the design of Point Rockway Lock are similar to those of the Analysis of Design for Robinson Bay Lock. A number of features common to both locks are described in detail in the Robinson Bay Analysis, to which frequent reference is made herein to avoid duplication. Therefore, the analysis of design for Robinson Bay Lock should be considered supplemental to the analysis for Point Rockway Lock. In general, the data given herein are limited to conditions peculiar to Point Rockway Lock or materially different from those of Robinson Bay Lock.

1-02. THE PROPOSED PROJECT. - (See Analysis of Design, Robinson Bay Lock.)

1-03. SOURCES OF INFORMATION AND DATA FOR DESIGN. - (See Analysis of Design, Robinson Bay Lock.)

1-04. DESCRIPTION OF LOCK.

(a) General. - Point Rockway Lock provides the small lift required to carry navigation through the side canal around Iroquois Dam, as outlined in the Annex to the Agreement (par. 1-02, Robinson Bay Lock Analysis). The lift at this site is created by the backwater slope of the pool around Iroquois Point plus the increase in stages above Iroquois Dam provided for the purpose of reducing velocities in the excavated channels in the vicinity of Galop Island and as results from the use of Iroquois Dam to throttle the discharge as required to hold the maximum stage at the Power House to El. 238 in the initial development. The lift will normally vary from about 1 to 5 feet. The location and dimensions of the lock are substantially as proposed by the Joint Board of Engineers in its report dated November 16, 1926 (par. 1-03, Robinson Bay Lock Analysis). With respect to the entire project for a controlled single stage development of the International Rapids Section of the St. Lawrence River, the lock as proposed herewith has the same function as contemplated by the Joint Board.

(b) Pertinent Data. - Horizontal dimensions of the lock chamber are the same as in the Welland Canal locks, in accordance with the aforementioned Agreement. See Analysis of Design, Robinson Bay Lock, for notes on the layout and dimensions of approach walls, which are the same for both locks. Other pertinent data and dimensions concerning Point Rockway Lock are listed below for convenient reference.

Hydrological Data:

Maximum High Water -(Max. Lake Ontario Level, no flow in river - - El.249)

| (Note:- Numbers in parenthesis refer to the footnotes below) | (1) Initial Development Max. Headwater El.238 at Power House | (1)Possible Future Developments,Max. Headwater exceeding El.238 at Power House |
|---|---|---|
| (2)Upper Pool Stages<br>Max. River Discharge (310,000 c.f.s.) | (3) El. 245.6 max.<br>(4) El. 242.8 | (3) El.245.6 max. (May 1870)<br>(4) El. 242.8 (Oct. 1869) |

Hydrological Data: (continued)

| | | |
|---|---|---|
| Possible Future Max. Headwater at Power House El. 242.3, river discharge=200,000 c.f.s. | - - - - - | El. 244.2<br>(May 1931) |
| (5) Minimum Headwater at Power House, El. 231 river discharge= 192,000 c.f.s. | El. 240.0 | El. 240.0<br>(Jan. 1936) |
| Minimum River Discharge (180,000 c.f.s. | (6) El. 243.6 | (6) El. 243.6<br>(Nov. 1934) |
| | (1) Initial Development Max. Headwater El. 238 at Power House | (1)Possible Future Development, Max. Headwater exceeding El.238 at Power House |
| (8)Lower Pool Stages Max. River Discharge (310,000 c.f.s. | (7) El. 240.1 max.<br>(4) El. 238.5 | (3)(9) El.243.2<br>(May 1870)<br>(4)El. 238.5<br>(Oct 1869) |
| Possible Future Max. Headwater at Power House, El. 242.3, river discharge=200,000 c.f.s. | - - - - - | El. 243.0(May 1931) |
| (5) Minimum Headwater at Power House El. 231, river discharge=192,000 c.f.s. | El. 236.2 | El. 236.2(Jan.1936) |
| Minimum River Discharge (180,000 c.f.s.) | (7) El. 239.0 | (10) El. 241.1<br>(Nov. 1934) |
| (11)Natural River Levels<br>Discharge = 310,000<br>" = 242,000<br>" = 180,000 | El. 230.4<br>El. 226.0<br>El. 222.2 | El. 230.4<br>El. 226.0<br>El. 222.2 |

(1) Conditions outlined in par.(e) Article IV of the Agreement. All stages computed by applying recorded discharges and Lake Ontario levels to the contemplated plan of operation known as "Plan No.5" Dates when certain stages would have obtained are shown in parenthesis.

(2) Stages immediately above Iroquois Dam and at the upper entrance to Point Rockway Canal; computed for channel enlargement as proposed by the present project plans.

(3) For max. Lake Ontario level, El. 249.

(4) For minimum Lake Ontario level, El. 243.8; headwater at Power House, El. 235.9.

(5) Winter conditions only; not significant with respect to navigation.

(6) For Lake Ontario level. El. 244.0.

(7) Headwater El. 238 at Power House.

(8) Stages at the lower entrance to Point Rockway Canal, approximately 3.3 miles downstream from Iroquois Dam.

(9) Headwater El. 241.5 at Power House.

(10) Headwater at Power House El. 240.3.

(11) Conditions that would exist only if pool at Power House were lowered, due to structure failure or other causes, sufficiently to restore natural river levels at the lower entrance to Point Rockway Canal.

Lift under normal operating conditions during navigation season - - - - - - - - - - - - 1' to 5'
Type of Lock Walls - - - - - - - - - - - - - - - concrete gravity-sections
(Note: Lock walls and gates were designed for stability for the lock-unwatered and construction conditions, which are more severe than the possible natural river level conditions referred to above.)
Lock Chamber dimensions - - - - - - - 80' wide by 800' clear length (nominal)
(length between inner gate pintles = 860')
Length of Approach Guide Walls, each end - - - - - - - - - - - - - 1200 feet.
Flare of Approach Guide Walls, each end - - - - - - - - - - - - 1 in 6.6
Top of Lock Walls - - - - - - - - - - - - - - - - - - - - - - - - - El. 252
Upper Emergency Dam Sill - - - - - - - - - - - - - - - - - - - - - El. 210
Upper Gate Sills - - - - - - - - - - - - - - - - - - - - - - - - - El. 206
Lower Gate Sills and Lower Emergency Dam Sill - - - - - - - - - El. 206
Ledge Rock - - - - - - - - - - - - - -varies from about El. 196 to El. 206
Maximum Height of Walls - - - - - - - - - - - - - - - - - - - about [illegible].

(c) Lock Sill Elevations. - In accordance with the criteria set forth in the aforementioned Agreement, lock gate and emergency dam sills have been set not less than 30 feet below minimum pool stages. This rule limits the upper sills to a miximum El. 210 and the lower sills to El. 206. The upper gate sills have been set at El. 206, same as the lower sills, the four foot excess height of upper gates being justified by duplication of the lower gate heights and the additional cost thereof offset by saving in sill concrete.

(d) Operational Equipment. - Sector-type lock gates were adopted in lieu of miter-type, due to the low operating heads which will permit filling and emptying the lock chamber by operation of the gates, thereby eliminating the necessity for a separate system of culverts and valves for filling and emptying. Use of sector gates for this lock was approved in the Conference on Navigation Structures referred to in par. 4-01, Analysis of Design, Robinson Bay Lock. Two gates are provided at each end of the lock chamber, to insure the maintenance of navigation in the event one gate becomes inoperative due to accident or other causes. Since sector gates can be opened or closed against a flow of water, only one gate at each end of the chamber need normally be used for passing navigation, the other being left in its recess for possible emergency use. Since any one of the four gates would be able to check the flow of water through the canal in case of accident, the provision of a guard gate in the canal was considered unnecessary. Wire rope fenders, same as those designed for Robinson Bay Lock, are provided on both sides of each set of gates to protect them against the possibility of being struck by ships. A movable bridge is provided across the upper end of the lock to afford access to Iroquois Dam and to the area between Point Rockway Canal and the river. Present plans contemplate only a highway crossing at this point, but the same bridge designed used at Robinson Bay Lock, providing for both highway and railroad loadings, was adopted to allow for the possible future addition of an access railroad. Stop log type emergency and unwatering dams, same as for Robinson Bay Lock, are provided at both ends of the lock chamber.

(e) Bombproofing. - (See Analysis of Design, Robinson Bay Lock)

## 1-05. LOCATION OF LOCK.

(a) Relation to Point Rockway Canal. - The location of the lock is of course primarily dependent on the location of Point Rockway Canal. The canal alignment on the Canadian Department of Transport plans for the controlled single stage project (see par. 1-05, Analysis of Design, Robinson Bay Lock) followed along a course of low ground that appears to be an ancient channel of the river, lying generally from 3,000 to 4,000 feet south of the present south bank of the river. The canal location adopted in this study of the project follows the same course with only slight changes in alignment as indicated desirable for best entrance conditions and maximum economy in construction. See part II of the Analysis of Design for Iroquois Dam for a discussion of canal location studies. Subsurface explorations indicated ledge rock at favorable elevations for lock foundations near both the upper and the lower ends of the canal. Extending between points about 2000 to 4000 feet downstream from the upper end of the canal, the ledge rock rises to El. 230 or higher; in this area a lock could be built along a trench excavated in the rock to navigation grade El. 206, using "perched" type concrete walls above the top of the rock and concrete lining on the rock faces of the lock chamber below the top of rock, similar to the Bonneville Lock design. Near the downstream end of the canal alignment the elevation of ledge rock varies from about navigation clearance grade to 10 ft. below that grade; in this area a lock of more conventional design, using gravity-type concrete walls for the full height of chamber, can be built. A detailed study, including comparative cost estimates for canal and lock, was made for the two possible lock locations. The results indicated that total costs for each location are about the same but that approach conditions are superior, the design of lock walls safer, and the probability of construction contingencies less for the lock location near the downstream end of the canal. Accordingly, the downstream location was adopted. This location of the lock is about 1000 feet downstream from that shown on the aforementioned Department of Transport drawings and was selected in preference to the Department of Transport location because it places the upper approach to the lock at a greater distance from the bend in the canal (see Sheet No. 1/1 of the drawings).

(b) Topography. - The topography at the proposed lock site is quite flat and lies only a few feet above adjacent normal river levels. See Sheet No. 1/2 of the drawings. Topography was an important consideration in locating the canal alignment but had no direct bearing on the selection of the lock site except as it affected overall excavation costs in the comparative estimates for the two possible locations, as noted in (a) above.

(c) Overburden. - The overburden at the site is composed of clay, sand, and gravel, varying in thickness from about 20 to 35 feet. The top material is clay, varying in depth from about 13 to 25 feet. The upper portion of the clay is generally a brown, silty type ranging in thickness from about 4 to 14 feet. The lower portion of the clay is a gray marine type ranging in thickness from about 4 to 25 feet. Underlying the clay and extending to ledge rock is a thin stratum of water-bearing sand or sand and gravel, varying in depth from zero to about 15 feet. The profiles of the material described above are irregular. In general the character and extent of overburden materials encountered did not directly influence the seclection of the lock site. The location of the site with respect to the river together with the profile of ledge rock and the character of overburden materials indicate that hydraulic dredging will probably be the most economical method of excavating for lock wall foundations. The clay from this excavation is not considered suitable for backfill or dike embankment construction; the underlying sand and gravel might be useful for some portions of required earth embankments if kept separate from the clay. See Sections II and III below for a detailed description of overburden materials at the site and their effect on the design of excavation slopes and embankment sections. See Sheets Nos. 2/1 to 2/6 inclusive, of the drawings for the record of subsurface explorations at the site.

(d) Ledge Rock. - Drill holes at the lock site revealed ledge rock at levels ranging from about El. 196 to El. 206, which are generally favorable as regards foundation grades for full gravity-section walls of a lock required to provide a navigation clearance grade at El. 206. There appears to be no general dip of the rock surface that would indicate the possible desirability of shifting the site one way or the other. The rock itself is the hard dolomite characteristic of this region and is considered generally excellent as a foundation for the heavy structures of the type contemplated. Reference is made to Sections II and III for a detailed description of the ledge rock and its suitability for foundations.

## SECTION II - INVESTIGATIONS OF OVERBURDEN AND BEDROCK.

### 2-01. FIELD EXPLORATION OF OVERBURDEN AND BEDROCK CONDITIONS.

(a) General. - Exploration at the Point Rockway Canal and Lock sites to determine the overburden and bedrock conditions included drilling in overburden and rock, excavation and sampling of auger holes, probing in soft overburden, the determination of bedrock elevations and study of general soil conditions by the seismic method. No exploration has been conducted to locate a borrow area to obtain suitable earth fill material. It is believed that sufficient quantity of material will be available from the canal excavation for embankments. The general conditions and surface topography of the bedrock were determined to locate the lock and alignment of the canal. The location of all drill holes and seismic lines completed to date are shown on Plate II-1 and are tabulated on Plate II-2 and II-3. The location and extent of exploration except seismic lines for final design and the records of drilling and probings between stations 159+00 and 250+00 are shown on Sheets Nos. 2/1 to 2/6 of the drawings for Point Rockway Lock. Similar drawings were prepared for the section of the canal between Stations 30+00 and 159+00 and are included with the drawings for Iroquois Dam. Complete field logs of the drill holes and probings, and the results of the seismic investigations are on file in the St. Lawrence River District Office. All soil samples and rock cores are stored in the District Soils Laboratory.

(b) Drill Holes. - Holes of two sizes were drilled in the vicinity of the lock and canal. Holes for the purpose of determining both overburden and bedrock conditions were drilled with diamond core drilling equipment using 3½-inch casing in the overburden and 2-1/8-inch bit to obtain rock cores. Soil samples were usually taken at 5-foot intervals or at changes in material with a dry sampling tube, 2 inches in diameter. One hole, D-1358, was drilled in the overburden in the vicinity of the lock using a 6-inch casing to obtain undisturbed samples of clay. A spoon specially constructed by Sprague & Henwood, Inc. was used. The spoon obtains samples 4-5/8 inches in diameter and has recessed flaps above the cutting shoe which are closed with a wire snare to retain the sample in the spoon. The spoon is also equipped with steel liners 0.12 inches thick and 12 inches long. In the entire length of the canal, 26 holes have been drilled using 3½-inch casing with a total footage of 626 feet in overburden and 520 feet in rock. One hole using 6-inch casing has been completed with a total footage of 32.3 feet in overburden. Fifteen undisturbed clay samples were obtained. Between Stations 159+50 and 250+00, 12 holes have been drilled using 3½-inch casing with a total footage of 345 feet in overburden and 22 feet in rock.

(c) Probings. - Holes were probed along the sides of the proposed canal and on the center line, in general spaced every 300 feet. The holes were probed with a Highmark Probing Machine using a 1-1/4-inch diameter probing pipe with a removable closed pointed end. Samples were taken with a sampler 3/8 inches in diameter after the closed pointed end was retracted without pulling the casing. The probing pipe was driven with a hammer weighing 104 pounds, dropping approximately 12 inches at an average rate of 60 blows per minute. In the entire length of the canal 203 holes have been probed with a total footage of 2,412. Between Stations 159+50 and 250+00, 9 probe holes have been completed with a total footage of 1,240 feet.

(d) Auger Holes. - Holes 1½ and 3 inches in diameter were augered in the valley and on the hills in the vicinity of the canal to determine the overburden conditions which govern the location of spoil areas. A sufficient number of auger holes were excavated to determine the approximate extent of the clay areas. No record was kept of the location of the holes or the soil conditions at each hole. The limits of the clay areas were sketched in the field on a topographical site map.

(e) Seismic Investigations. - Preliminary investigations for determining the location of bedrock and existing soil conditions in the vicinity of the canal were conducted using the seismic method. The method used was developed by E. R. Shepard, Senior Physicist, Office of the Chief of Engineers (for a brief description, see article "The Seismic Method of Exploration Applied to Construction Projects" by E. R. Shepard, The Military Engineer, September-October 19[illegible]). A total of 56 seismic lines were fired in the vicinity of the canal. A complete report of the investigations is on file in the district office.

## 2-02. METHOD AND EXTENT OF LABORATORY TESTS AND INVESTIGATIONS.

(a) Soil Tests. -

(1) Due to the depth of excavation for the canal an extensive program of soil testing was not made on samples taken from the canal area. No tests have been made to determine the suitability of the excavation materials for earth fill embankments. Based on experience with similar materials it is concluded that excavation material other than clay may be used for embankment construction. Undisturbed clay samples from D-1338 in the lock site were tested to determine the shearing strength and consolidation characteristics. All soil samples taken during drilling were classified using the M.I.T. scale of classification and recorded in a final report of each hole.

(2) No natural density or permeability tests were conducted. Moisture contents of [illegible]9 samples from drill holes were determined. Liquid limit, specific gravity, plastic limit determinations were made on the clay of cylinder sample No. 10 from D-1338 taken at a depth of 19.5 feet. The results were as follows:

Specific gravity - 2.75
Liquid limit -42.4%
Plastic limit -25.6%

(3) Shear and consolidation tests were made on the clay of samples from hole D-1338. A consolidation test was made on a specimen 1-1/4 inches thick and 4-1/2 inches in diameter taken from cylinder sample No. 10. The results are shown on Plate II-4 and II-5. Quick shear tests were made on several samples from D-1338 and the results are shown on Plate II-6. These tests were made in accordance with the procedure described in detail in the Analysis of Design of the Long Sault Canal. A complete report on all consolidation and shear testing prepared by the Syracuse District Soils Laboratory is on file in the district office.

(b) Rock Tests.- The rock cores obtained by drilling were classified by an experienced geologist. The bedrock in the vicinity is dolomite of the Beekmantown formation and was apparently deposited at the same time as the bedrock in the vicinity of the quarry operated by the Northern Quarries, Inc., near Norwood, N. Y. Extensive tests are being conducted at the Central Concrete Laboratory to determine if the dolomite rock from the quarry of Northern Quarries, Inc. is satisfactory for concrete aggregate. Tests completed to date indicate that the rock will be satisfactory. To compare the bedrock which must be excavated in the canal with that from the quarry operated by Northern Quarries, Inc., cores obtained by drilling have been sent to the Central Concrete Laboratory for examination and test. Prior to letting the contract for excavation of the bedrock it is planned to make sufficient tests to definitely determine the suitability of the rock in the canal excavation for concrete aggregate.

## SECTION III - DESIGN OF CANAL AND LOCK EXCAVATION SLOPES AND DIKES, AND CHARACTERISTICS OF MATERIALS TO BE EXCAVATED

### 3-01. CHARACTERISTICS OF OVERBURDEN.

(a) Distribution. - The overburden through which the canal and lock site will be excavated is variable and consists of marine clay, glacial till and water-laid or partially water-laid sands. The geological origin of the materials is described in paragraph 1-03(c) of the Analysis of Design, Iroquois Dam. The canal and lock sites are bounded by hills composed of glacial till with the valleys between the hills being filled with clay. The canal and lock sites, in general, are located in a clay valley. In some areas water-laid or partially water-laid sands have been deposited between the clay and the glacial till. As these conditions are very variable, a specific distribution of the various materials cannot be made with great accuracy with the information available. Using the data from the drilling and probings, and geological profiles between stations 195+50 to 250+00 as shown on Plates III-1 to III-3 have been prepared. Similar profiles were prepared for the section of the canal between Stations 30+00 and 157+00 and are included in the Analysis of Design for the Iroquois Dam. The basic data for the profiles are shown on Sheets Nos. 2/1 to 2/6 of the drawings. In preparing the profiles, it was assumed that the rate of probing in clay was less than 72 feet per hour, and therefore a probing rate greater indicated material other than clay.

(b) Characteristics of Clay.

(1) The marine clay deposits consist of soft, grey, silty clay underlying at a depth from zero to approximately 10 feet, brown sandy clay. The brown, sandy clay is mainly deposited on the valley slopes and in the vicinity of the lock. Typical grain size curves of the grey, silty clay are shown on Plate III-4. The laboratory tests show that in general the grey clay consists of approximately 10 percent by weight collodial sizes. The water contents of grey clay varies between 40 and 70 percent but has an average of approximately 50 percent by weight. Based on this average water content, the grey clay has an average void ratio of 1.35, a unit dry weight of 72 pounds and unit saturated weight of 108 pounds.

(2) The shearing strength of the clay at the lock site is variable with depth. The upper 10 to 15 feet is quite firm with a shearing strength of about 1200 pounds per square foot as indicated by the results on Plate II-6. The underlying grey clay is quite soft. The results of a few quick shear tests shown on Plate II-6 show that the average shearing strength is greater than 500 pounds per square foot. It is believed that the clays in the canal area have similar shearing strengths.

(c) Characteristics of Glacial Till. - The deposits of glacial till consists of fairly compact to compact clayey or silty gravelly sand, with scattered cobbles and boulders. In general the till near the exposed surface and contract surface with the clay contains less silt or clay than the underlying till. Within any deposit, there may be a great variation in the quantity of clay or silt which acts as a binder. The density and compactness depends upon the percentage of clay and silt particles but in general the till is very compact. Plate III-4 shows grain size curves of various samples of till which are believed to be typical. No shear tests were performed on glacial till samples since experience with similar materials has shown that an angle of internal friction of 30 degrees and a cohesion of 0.10 tons per square foot may be used to obtain a conservative design. The glacial till is relatively impervious having a coefficient of permeability varying between 0.0001 and 0.000001 cm. per second.

(d) Characteristics of Overburden other than Clay and Glacial Till.

(1) The overburden other than clay and glacial till in the canal areas consists of water-laid or partially water-laid sands and gravels, muck and marl. The characteristics of these materials are quite variable. No samples can be considered typical. For design purposes, it must be assumed that in locations where unusual conditions exist that stable side slopes will be formed during construction.

(2) At the lock site underlying the soft grey clay is a strata a few feet thick of water bearing, variable silty sand and gravel. Artesian flows as great as 30 gallons per minute were encountered during drilling when the hole extended nearly to rock. Artesian flow was encountered at drill holes D-1073, D-1264, D-1270, D-1276 and D-1280. The previous stratum is continuous in the area since operations at a hole in a lower area would stop the artesian flow in a hole at a higher elevation.

3-02. CHARACTERISTICS OF BEDROCK. - Descriptions of the bedrock at the holes drilled between Stations 159+50 and 250+00 are shown on Sheet No. 2/6 of the drawings, and the bedrock contours are shown on Plate II-1. The bedrock is quite sound, and with a nominal grouting should provide a sound foundation for the proposed lock structure. The upper five to ten feet of the bedrock may be sufficiently jointed and weathered along the seams to make it unsuitable for concrete aggregate, although most of the rock is believed suitable. All bedrock is sufficiently sound for use as riprap and cofferdam construction.

3-03. ANALYSIS OF CANAL SLOPES. - No mathematical analyses have been made to determine the excavation slope in the canal required for safety against major slides. A study has been made of the depth of cut in clay and depth of clay. Based on this study and the results of analyses made for the excavation slopes for the Long Sault Canal, it is believed that a slope of 1 on 2½ will be amply safe against major slides. In some sections of the canal where unusual soil conditions exist, it may be necessary to excavate the slopes flatter than 1 on 2½. However, where these conditions exist, the slope that can be constructed, is believed to be stable after construction. A slope of 1 on 2½ was selected for the design throughout the length of the canal since. Based on experience, this slope will minimize maintenance.

3-04. SPOIL AREAS. - The rock excavated from the canal will be utilized in the construction of the lock and dike and stockpiled for future use as concrete aggregate, riprap, and rock fill for other structures. To prevent stockpiled rock from sinking into the overburden, the rock spoil area has been located on a deposit of firm overburden. The location of the spoil areas for material to be excavated between Stations 159+50 and 250+00 are shown on Sheets Nos. 1/3 and 190/1 of the drawings. The location of the clay and firm material deposits along the canal as determined by the exploration described in paragraph 2-01(d) are shown on Plate III-5. Spoil areas for unclassified material have been located to insure the stability of the excavation slopes of the canal.

3-05. LOCK EXCAVATION SLOPES. - The excavation slopes for the lock are located in a deposit of clay to a depth between 20 and 30 feet which overlies a few feet of variable sand and gravel. Based on the shearing strength as described in paragraph 3-01(b), and a few preliminary analyses by the circular slide method, it was concluded that slopes of 1 on 3 during construction would be safe. During construction, a considerable flow of water may enter the excavation area through the variable sand and gravel layer above the bedrock.

The extent to which this flow water may produce construction difficulties is not known. However, if the flow is sufficient to cause transportation of material from the slope, a rock protective blanket will be constructed. An ample quantity of rock is available from the canal excavation.

3-06. ANALYSIS OF DIKES AND BACKFILL. - Foundations for the dikes on both sides of the lock consist generally of a layer of fairly stiff clay overlying soft clay with extends down to the rock, till, or water-laid sand and gravel; see par. 3-01(a). Preliminary analyses for a dike of the 25 ft. maximum height required on the clay foundations described above indicate that a section constructed of till or similar suitable materials will be stable with 1 on 3 side slopes as shown on the drawings. The dike sections adjacent to the lock walls will be founded on compacted backfill constructed of the same class of materials as the dikes. Backfill placed against the lock and approach walls will be constructed of till or granular materials from required excavation; the slope of 1 on 2½ shown on the drawings for the backfill embankments is believed suitable for stability in view of the height of embankments, foundation conditions, character of material to be used, and the non-critical nature of the backfill as a permanent structure. The explorations indicate a substantial volume of till and/or water-laid silty sands and gravels of variable character withih portions of the required lock and canal excavations. It is expected that these materials will be suitable for backfill embankment construction and in the outer portions of the dike sections if they are effectively separated from the overlying clay by the excavation methods and procedure used. However, even if a substantial part of these materials are so used, considerable additional material will have to be borrowed to complete the dike and backfill embankments required. No subsurface exploration has been made for prospective borrow areas in this vicinity, but a surface reconnaisance of the area indicates that the ridges on both sides of the work site contain suitable materials in ample quantity. Such areas lying within the designated work limits will be available for borrow. In addition it is expected that a large quantity of suitable materials excavated from point Three Points Cut under separate contract will be spoiled on the west side of the canal close to the lock site, as indicated on Sheet No. 1/3. These spoil dumps will also be made available for borrow materials.

## SECTION IV - HYDRAULIC DESIGN

### 4-01. FILLING AND EMPTYING SYSTEM.

(a) General. - As noted in par. 1-04(d) above no separate system of culverts and valves is provided for filling and emptying the lock chamber, it being planned to use the lock sector gates for this purpose. A number of existing locks equipped with sector gates are operated satisfactorily in this manner, including Moorehaven, Ortona, and St. Lucie Canal Locks in the Lake Okeechobee Drainage Area, Florida, the Chicago River Lock and the Calumet Sag Canal Lock. Some of these operate at considerably greater heads than the maximum lift of approximately 5 feet expected at Point Rockway Lock. In addition to the above, a number of other locks have been designed for sector gate filling and emptying including the Passamaquoddy Tidal Power Project Lock, Maine, the Bayou Sorrel Lock, Louisiana, and the Brazos River Division Channel Floodgates, Texas (designed for later conversion to locks). The Bayou Sorrel Lock was designed for operation at 17.5 ft. head and the Passamaquoddy Lock at maximum of 27 ft. head. Hydraulic model tests for the latter indicated that sector gate filling is practicable even for heads of that amount. Prototype filling tests at the Ortona (Florida) Lock for heads up to 12.3 feet indicated very little turbulence and low hawser stresses on a barge tied up in the lock chamber. The Ortona Lock and several of the other locks noted above provided for discharge only through the center opening between gate leaves as they are swung apart. The Passamaquoddy Lock design provided for discharge through the recesses behind the gate leaves as well as through the center opening between them. The latter arrangement is probably better for high-head installations, as the opposed jets issuing from the sides help to dissipate the total energy of inflow. Design for flow through the center only permits some simplification in details of gates and recesses and assures against floating ice or other debris being drawn into the recesses. Prototype tests have indicated that turbulence from filling through a center opening only are negligible for heads considerably greater than the normal one to five feet expected at Point Rockway, so this type design was adopted. The use of center-filling sector gates for Point Rockway Lock was approved at the Conference referred to in par. 4-01(a), Analysis of Design, Robinson Bay Lock.

(b) Operation. - The rate of filling ( or emptying) the lock chamber will of course depend on the rate of opening the sector gate. The rate of gate opening should be as rapid as permitted by the surge effects of the inrushing water on vessels moored in the lock chamber. No effort has been made to compute the probable maximum safe rate of gate opening. This can best be determined by trial operations after the lock is built. To allow for adjustments in gate speed, the machinery will be equipped with a two-speed motor and limit switch providing means for varying gate opening time from a minimum of 1½ minutes to a maximum of about 4 minutes, assuming continuous operation. The effective rate of opening can of course be slowed to any desired degree by stopping the motor at a selected point of gate travel. It is believed that the 1½ minute opening time - same as adopted for opening the miter gates at Robinson Bay Lock - will be as low as permitted by surge effects in the lock chamber. Whatever rate of gate opening is adopted as a result of field tests will undoubtedly provide a much shorter time of lock filling or emptying than possible at Robinson Bay Lock, and therefore will not affect the traffic capacity of the waterway.

4-02. LOCK UNWATERING SYSTEM. - The same number, size, type and arrangement of pumps will be used as provided at Robinson Bay Lock, installed similar to the unwatering pumps at Grass River Lock. See the Analysis of Design for each of those Locks. Sheet No. 15/2 of the drawings shows the location and general arrangement of pumps and the intake and discharge culverts.

4-03. MACHINERY RECESS DRAINAGE. - The river stages will frequently be such that drainage of rain water from some of the machinery recesses cannot be effected by gravity. Therefore, a header drain is provided in each lock wall, leading to a sump near the lower end of the lock, for collecting drainage from machinery recesses, cable galleries etc. A small pump with float-switch controlled motor is provided in each sump wall to discharge the drainage into the lower pool. See Sheet No. 15/2 of the drawings.

## SECTION V - STRUCTURAL DESIGN - CONCRETE

### 5-01. STABILITY ANALYSES

(a) Loading Assumptions. - Same as in Analysis of Design, Robinson Bay Lock, except as follows: Backfill against lock walls might be constructed of the pervious sand and gravel from the lower part of the lock excavation. Therefore, the wall sections were analyzed for earth weights of 110 lb./c.f., dry, and 125 lb./c.f., wet, as well as for the corresponding till values of 120 lb./c.f. and 130 lb./c.f., respectively.

(b) Design Criteria. - Same as in Analysis of Design, Robinson Bay Lock, with respect to wall sections founded on rock. No concrete structure foundations on till or bearing piles are contemplated at Point Rockway Lock.

(c) Approach Walls. - Stability analysis of the approach walls are shown graphically on Sheet No. 15/A of the drawings. The walls are designed as gravity sections with backfill to the top. Backfilling approach wall appeared desirable at this lock for the following reasons:

(1) Both the upper and lower approach walls are founded on ledge rock since it lies at elevations close to required navigation channel grades. Walls founded on sound rock are not likely to slide or tip under the heavy horizontal pressure of backfill.

(2) Due to the rigidity of rock foundations the resistance of walls not backfilled to boat impact would be limited by the relatively small elastic deflections of the wall section and the foundation rock. Analyses indicated that without backfill a somewhat wider and heavier wall section would be required to resist probable boat impact forces than the section required to resist the full static loading of backfill. Because of the active earth pressures, plus the reserve of passive earth pressures developed by defection of the wall, a wall section backfilled to the top is considered safe against any probable boat impact forces.

(3) Estimates indicate that for these walls backfill will probably be cheaper than a slab-and-buttress type concrete deck similar to that provided for operating space at the top of the approach walls for Robinson Bay Lock, even if all the material has to be borrowed from adjacent till ridges.

(4) There is no requirement at this lock for water channels back of approach walls leading to or away from a discharge culvert similar to the lower pool supply system at Robinson Bay Lock.

The walls are designed for the construction condition of full backfill prior to flooding the channel. If large quantities of ground water are encountered in the foundation excavation (see paragrpah 3-01(d)) it may be desirable to provide a pipe drain through the wall in each monolith at El. 220 or lower, to prevent high saturation levels than assumed in design. Such drains, if provided, should be backed by suitable pockets of gravel to avoid loss of fill material and clogging of the drain.

(d) Lock Chamber Walls. - Stability analyses of the lock chamber walls are shown graphically on Sheet No. 15/A of the drawings. These walls are of gravity section and founded on ledge rock throughout their entire length, and have a maximum height of about 59 feet. Backfill will be placed against these walls, material being obtained from the lower part of the lock excavation or by borrow from nearby areas; seepar. 3-06. The critical loading condition on the wall between gate bays is developed by the backfill when the lock chamber is unwatered. Lowering of the saturation level by means of a gravel drain back of the walls, as used at Robinson Bay Lock, is not practicable here due to the small difference in upper and lower pool levels. The gate bay sections were analyzed, on the basis of full monolith lengths, for the lock-unwatered condition with the gate leaf swung out to fully-closed position. In addition, the blocks were reviewed for the condition of gate thrust and hydrostatic pressure due to maximum water level above gate and lock unwatered below gate and also for the condition of gate thrust due to a difference of 5 feet between upper and lower pool levels. Reference is made to Sheets Nos. 15/1 and 15/2 of the drawings for the layout of gate bay monoliths. While each of these blocks was analyzed as a free body, it is apparent that they will act together in resisting the loading because of their wedge-like shapes and relative positions. To further insure such interaction of blocks it is proposed to form large shear keys in the joints between all gate bay monoliths. In view of these considerations some reduction in the standard design criteria for stability, referred to in paragraph 5-01(b) above, was considered justified when the blocks were analyzed as free bodies. Accordingly, the monoliths so analyzed were considered satisfactory for stability if the computed foundation tension at any corner did not exceed 2000 lb./sq. ft. (14 lb./sq. in.), so long as the analysis indicated maximum foundation compression and sliding factors within the allowable values set forth in the design criteria.

(e) Gate and Emergency Dam Sills. - Due to the relatively high foundation rock, the gate and emergency dam sills are designed as gravity structures, rather than arches as at Robinson Bay Lock. The emergency dam sills and the upper gate sills are designed for stability against the maximum pool levels at which the emergency dams permit unwatering as indicated on the drawings. Stability analyses of the sills are shown graphically on Sheet No. 15/A of the drawings.

5-02. STRESS ANALYSES. - Subparagraph (a) and (b) of par. 5-02, Analysis of Design, Robinson Bay Lock, are applicable to Point Rockway Lock.

5-03. MASONRY DRAWINGS. - Due to very limited time and personnel available for the preparation of drawings for Point Rockway Lock, it was not possible to detail the concrete masonry structures as completely as was done for Robinson Bay and Grass River Locks. Except for certain recesses and clearance dimensions shown on some of the structural steel and machinery drawings, details of concrete structures layout and dimensions are limited to two general plan and sections sheets. Since no culverts and valves are required for filling and emptying the lock chamber or for other purposes, since the walls are of uniform height and are founded throughout on rock, and because other simplifications in layout and design have been made, it is believed that the two sheets will suffice for bidding purposes if necessary. If possible, however, supplemental drawings to complete the masonry details should be prepared prior to advertisement.

## SECTION VI - STRUCTURAL DESIGN - STEEL

6-01. DESIGN CRITERIA. - (See Analysis of Design, Robinson Bay Lock).

6-02. LOCK GATES. - The lock gates are of sector type, generally similar to the gates at the locks referred to in par. 4-01 above and patterned particularly after the gates at Ortona and other locks in the Lake Okeechobee Drainage Area, Florida. The gateleaf is made up of a number of horizontal, segmental-shaped frames which transfer the water load from the plated face on the arc of the segments, through radial struts to a vertical girder connecting the ends of the frames together; the vertical girder distributes the thrust to three bearings, two hinges and a pintle, on which the leaf is swung. See Sheets Nos. 50/1 and 50/2 of the drawings for framing and details of the gate leaf. The gate is designed to take the hydrostatic load for pool at maximum high water El. 249 and lock chamber unwatered, a possible condition in the case of the upper gates. In addition, the gate design was reviewed for hydrostatic load with pool at El. 246 plus ice pressure of 10,000 lbs. per linear foot distributed vertically between El. 242 and El. 246, similar to the criterion used in the design of the Iroquois Dam. This is considered very conservative in the case of the lock sector gates, because

(1) The upstream emergency dam would normally be used for lock unwatering rather than the upper sector gates, and

(2) The converging entrance to the lock should produce arching of the ice between the guide and wing walls, thereby relieving the gate (or emergency dam) of much of the pressure resulting from expansion of the ice sheet in the canal above the lock.

Regardless of these considerations as to probability or magnitude of ice pressures, the analysis for the assumed conditions indicated that stresses would not exceed allowable values. Hinge and pintle bearings are proportioned to provide bearing stresses not exceeding 3,000 lbs. per sq. in. for the normal maximum head of 5 ft. under which the gate may be required to operate and not exceeding 10,000 lbs. per sq. in. for the maximum 43 ft. head which the gate may be required to resist in the closed position. Side sealing of the gate in the closed position is effected by bearing of a "J" type rubber strip attached to the face of the recess on the projecting leg of an angle attached to the face of the gate; at part-open gate positions, the small clearance between this seal strip and the curved face of the gate limits the flow into the recess to a small amount. Bottom sealing of the gate in the closed position is effected by bearing of an "L" type rubber strip attached to the gate on the flat surface of metal fixed in the sill. This sill sealing surface and the seal on the gate are sloped slightly and parallel to each other so that contact is established by wedge-type action in the last few feet of gate closure. The upper and lower gates are made the same height (see par. 1-04(c) above) and of identical design, thereby simplifying fabrication, erection, and maintenance and making the corresponding leaves of all four gates interchangeable.

6-03. EMERGENCY AND UNWATERING DAMS. - Same as for Robinson Bay Lock, (See Analysis of Design) except as to required number of stop logs and as to manner of storage of the stop logs at the upstream and of the lock chamber. Since the lift is so small at this lock, a storage pit at the upstream end could not be drained by gravity but would require periodic pumping to keep it dry. A pit would also add materially to the cost of the lock wall, because of the large area already occupied by the adjacent sector gate recess. Therefore, it is proposed to store the upstream logs, as well as the downstream ones, on the backfill at the top of wall level. They will be placed back far enough so as not to interfere with normal lock operations. See Sheets Nos. 105/1 to 105/4 inclusive, of the drawings for emergency dam derricks and stop logs storage, the stop logs and the pick-up boom.

6-04. WIRE ROPE FENDERS. Same as for Robinson Bay Lock (See Analysis of Design), except that one additional 80-ft. fender is required for protection of the upper gates from the downstream side. At Robinson Bay and Grass River Locks this protection is afforded by the upper gate sill, which in both cases extends above the lower pool level. At point Rockway Lock the upper gate sills are at the same elevation as the lower sills, therefore affording no protection to the upper gates against being struck by upbound navigation entering the lock chamber. The fender will be identical with Fender No. 2, Robinson Bay Lock, except the boom will be operated from the left-hand wall instead of the right-hand. See Sheets Nos. 95/1 to 95/4 inclusive, of the drawings for location, assembly and details of fenders.

6-05. MOVABLE BRIDGE. - Same as for Robinson Bay Lock (See Analysis of Design) except that provisions for a present railroad crossing are omitted. The brdige is designed for railroad as well as highway loading, however, and will be fabricated and erected so as to permit the ready installation of ties, rails, etc. if it should be decided at a future date to construct a railroad for access to the area between the canal and the river. See Sheets Nos. 90/1 and 90/2 of the drawings.

## SECTION VII - MECHANICAL DESIGN

7-01. SCOPE OF DESIGN AND GENERAL CRITERIA. - Same as par. 7-01, Analysis of Design, Robinson Bay Lock, insofar as applicable to machinery for the sector gates, emergency dam derricks, wire rope fenders and the moveable bridge for Point Rockway Lock.

7-02. LOCK GATE MACHINERY. - Strut-and-sector type operating machinery similar to but somewhat smaller than that used for miter gates at Robinson Bay Lock, was adopted for the Point Rockway Lock sector gates. The complete machine consists of a strut with hinged ends connecting the top frame of the gate leaf with a cast steel, toothed sector mounted on the lock wall, this sector being engaged by a pinion which in turn is driven by an electric motor through a commercial type, fully-inclosed speed reduction unit. See Sheet No. 55/1 of the drawings. The machinery is equipped with a limit switch, motor tail brake, shear coupling in the shaft between motor and speed reducer, and shock absorber springs in the strut between machinery and gate, all similar in function to the corresponding parts in the miter gate machines for Robinson Bay Lock; see par. 7-02, Analysis of Design for that structure. Another type of operation machinery given consideration consisted of a motor-driven pinion engaging a rack mounted on the outside of the curved face of the gate near its top, the pinion with it speed reduction gears and motor being mounted in recess on the lock wall. This rack-and-pinion type of machinery was used at several of the locks noted in par. 4-01 and would doubtless be satisfactory for the Point Rockway Lock gates. However, the strut-and-sector type machine was considered more desirable in this case for the following reasons:

(1) The operating principle is the same as for the miter gate machines at Robinson Bay and Grass River Locks and the corresponding parts are similar though of generally smaller size. (Note: The machines for operation of the larger sector gates for the Long Sault Guard Gate Structure will duplicate the miter gate machine in all parts except, perhaps, the bedplate; see Analysis of Design, Long Sault Guard Gate.)

(2) Periodic adjustments required for the rack-and-pinion type machine to provide for proper fit of pinion teeth with rack teeth after changes in length of gate leaves due to temperature changes will not be necessary for the strut-and-sector type machines.

(3) For a given size motor the strut-and-sector type machine provides a greater surplus of power for moving the gate at the point of maximum power requirement (Just short of fully closed position) than the rack-and pinion type machine.

The costs of the two types of machinery are believed to be about the same. As noted in par. 4-01(b) it was desired to provide sufficient power to open a gate in as short a time as 1½ minutes. Based on estimated friction values for the bottom seal and for hinge and pintle bearings and a hydrostatic head of 5 feet (U.P. EL. 247; L.P. EL. 242), computations indicated that with a proposed total speed reduction of 2384:1 a motor rated 15/5 HP, 900/300 R.P.M. would meet this requirement, assuming operating at the high speed for all except the last few inches of travel. If operated at the slow speed throughout the travel the time of operation would increase to about 4 minutes. A limit switch is provided to permit such distribution of gate travel between slow and high speeds as field tests indicate necessary to provide the desired filling and emptying time and to stop the machinery at the ends of gate travel. A tail brake on the motor assures instant stoppage and holds the gate leaf in any position at which the machinery is stopped.

7-03. EMERGENCY DAM DERRICK MACHINERY. - (See Analysis of Design, Robinson Bay Lock and Sheet No. 105/1 of the drawings herewith.)

7-04. WIRE ROPE FENDER MACHINERY. - (See analysis of Design, Robinson Bay Lock, and Sheets Nos. 95/2, inclusive of the drawings herewith.)

7-05. MOVABLE BRIDGE MACHINERY. - (See Analysis of Design, Robinson Bay Lock, and Sheet No. 90/2 of the drawings herewith.)

## SECTION VIII - ELECTRICAL DESIGN

### 8-01. ELECTRICAL SYSTEM.

(a) General Description. - Similar to par. 8-01(a), Analysis of Design, Robinson Bay Lock except that the principal uses to be served by the system are as follows:

(1) Power for operation of four sector gates.
(8 - 15/5 HP, 900/300 RPM, 440 V. motors)

(2) Power for operation of two stiff-leg derricks
(2 - 440 V. motors, estimated 100 HP, 900 RPM)

(3) Power for operation of movable bridge.
(4 - 440 V. motors, estimated 30/10 HP, 900/300 RPM)
(2 - 440 V. motors, estimated 5 HP, 600 RPM)

(4) Power for operation of unwatering pumps.
(2 - 440 V. motors, estimated 200 HP, 600 RPM)
(1 - 440 V. motor, estimated 5 HP, 1800 RPM)

(5) Power for operation of four wire rope fenders.
(4 - 30/10 HP, 900/300 RPM, 440 V. motors)
(4 - ½ HP, 600 RPM, 440 V. motors)

(6) Power for lighting lock and approach walls.
(Approx. 50 - 10,000 lumen sodium-vapor lamps)

(7) Power for flood-lighting sector gate recesses.
(8 - 200-watt incandescent lamps)

(8) Power for signal lights.

(9) Power for miscellaneous lighting and general utility.

(b) Scope of Design. - Similar to par. 8-01(b), Analysis of Design, Robinson Bay Lock, except the reduced scope of masonry drawings for Point Rockway Lock (see par. 5-03 above) permitted even less detailing of galleries conduit runs, pull boxes, etc. than at Robinson Bay Lock.

8-02. OPERATIONS BUILDING. - Similar to par.8-02, Analysis of Design Robinson Bay Lock.

8-03. GALLERIES AND CONDUITS. - Similar to par. 8-03, Analysis of Design, Robinson Bay Lock.

8-04. LIGHTING. - Similar to par. 8-04, Analysis of Design, Robinson Bay Lock.

8-05. CONTROL. - Similar to par. 8-05, Analysis of Design, Robinson

Bay Lock, except that the upper bay control station will provide control only for operation of the two upper sector gates, the upper approach wire rope fender (No. 1) and the upper fender in the lock chamber (No. 2), the movable bridge, and the upper approach signal lights; and the lower bay control station will provide control only for the operation of the two lower sector gates, the wire rope fenders above and below the gates (No. 3 and 4), and the lower approach signal lights.

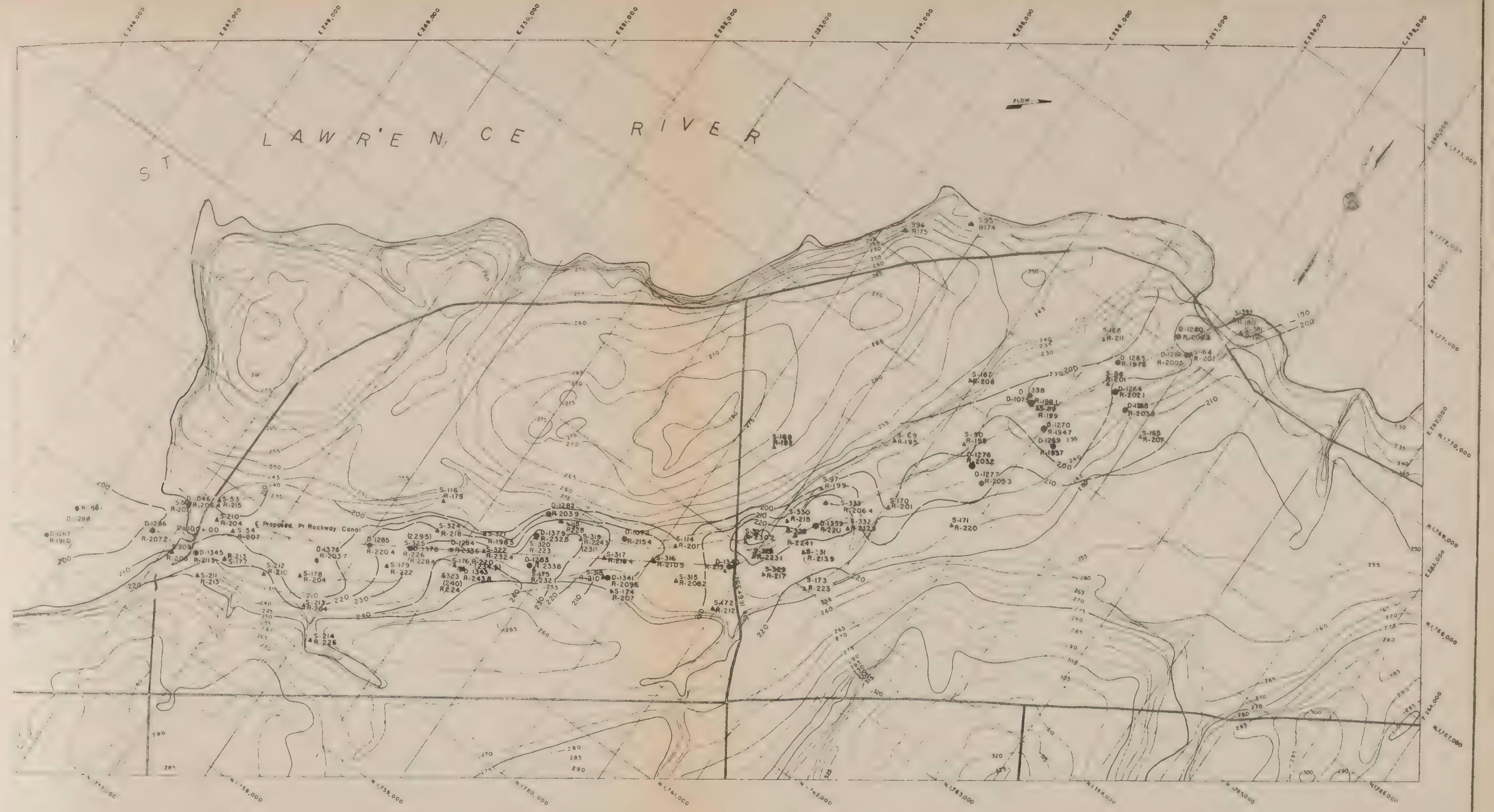
## SECTION IX - MISCELLANEOUS ITEMS

9-01. CHECK POSTS. - Same as for Robinson Bay Lock. See Sheet No. 15/3 of the drawings.

9-02. CORNER PROTECTION. - Same as for Robinson Bay Lock approach walls. At Point Rockway Lock a coping curb along the lock chamber walls is considered unnecessary in view of the low lift. Therefore, the simple corner protection detail used on the approch walls is provided also on the lock chamber walls. See Sheet No. 15/3 of the drawings.

9-03. RECESS COVERS. - Similar to details used for Robinson Bay Lock. See Sheet No. 15/3 of the drawings.

# APPENDIX "A"



LEGEND

- ● DRILL HOLE
- ▲ CENTER OF SEISMIC LINE
- R DENOTES ROCK ELEVATION
- (240' PROBABLE FRACTURED ROCK

NOTES

ELEVATIONS CONFORM WITH U S G S DATUM

ST. LAWRENCE RIVER PROJECT
POINT ROCKWAY CANAL
SITE & ROCK CONTOUR MAP
SOILS & FOUNDATIONS EXPLORATION

| IN SHEETS | SHEET NO | SCALE 1" = 500' |
|---|---|---|
| | 1 | |

U S ENGINEER OFFICE, MASSENA, NEW YORK FEB, 1942

| SUBMITTED | RECOMMENDED | APPROVED |
|---|---|---|
| B M Hauser<br>ENGINEER | LT. COL. CORPS OF ENGINEERS | COL. CORPS OF ENGINEERS<br>DISTRICT ENGINEER |

| DRAWN BY J E B<br>CHECKED BY | QL-A-2/1<br>FILE NO | TRANSMITTED WITH LETTER OR ENDORSEMENT<br>DATED 194 |
|---|---|---|

## LOCATION OF DRILL HOLES

## POINT ROCKWAY CANAL

| Hole No. | Mercator Coordinates North | Mercator Coordinates East |
|---|---|---|
| D-1072 | 1,763,222 | 254,573 |
| D-1073 | 1,767,440 | 257,710 |
| D-1263 | 1,768,466 | 258,311 |
| D-1264 | 1,768,155 | 258,495 |
| D-1265 | 1,768,040 | 258,720 |
| D-1269 | 1,767,160 | 258,250 |
| D-1270 | 1,767,275 | 258,035 |
| D-1276 | 1,766,400 | 257,570 |
| D-1277 | 1,766,290 | 257,780 |
| D-1280 | 1,769,150 | 258,740 |
| D-1281 | 1,769,035 | 258,970 |
| D-1282 | 1,762,945 | 253,650 |
| D-1283 | 1,762,290 | 253,810 |
| D-1284 | 1,761,900 | 252,900 |
| D-1285 | 1,761,365 | 252,060 |
| D-1286 | 1,759,952 | 249,752 |
| D-1287 | 1,759,141 | 248,665 |
| D-1288 | 1,759,626 | 248,801 |
| D-1338 | 1,767,487 | 257,658 |
| D-1339 | 1,764,745 | 256,422 |
| D-1340 | 1,763,699 | 255,835 |
| D-1341 | 1,762,726 | 254,678 |
| D-1343 | 1,761,782 | 253,146 |
| D-1345 | 1,760,052 | 250,336 |
| D-1376 | 1,760,838 | 251,613 |
| D-1378 | 1,761,632 | 252,480 |
| D-1379 | 1,762,631 | 253,680 |

Plate II-2

## LOCATION OF SEISMIC LINES

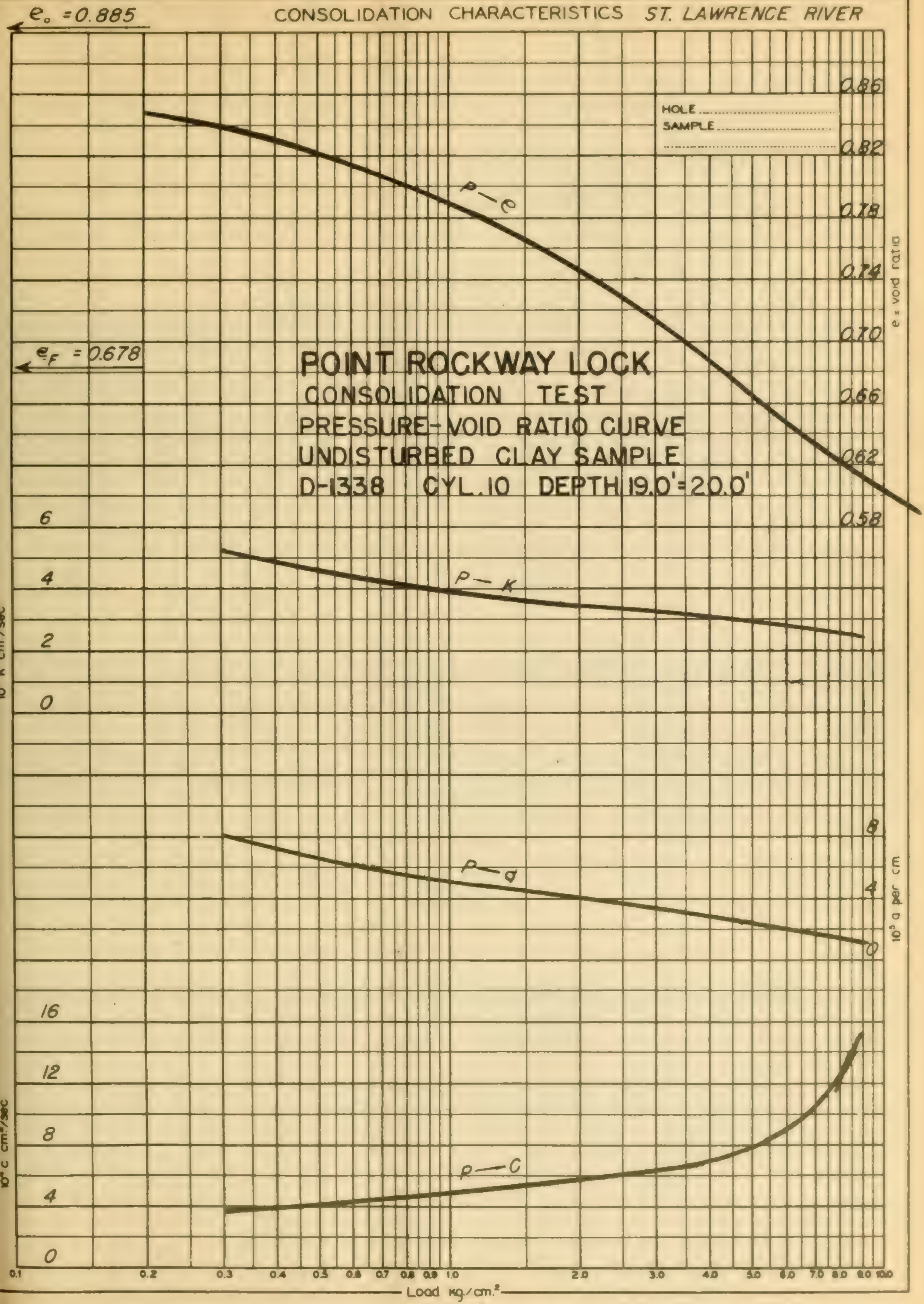
## POINT ROCKWAY CANAL

| Line No. | Mercator Coordinates N. | Mercator Coordinates E. | Surface elevation at center point | Rock Elevation |
|---|---|---|---|---|
| 50 | 1,760,508 | 249,891 | 231.5 | 206.5 |
| 53 | 1,760,762 | 250,196 | 241.6 | 215.0 |
| 54 | 1,760,526 | 250,553 | 232.4 | 207.0 |
| 55 | 1,761,337 | 249,072 | 266.3 | 203.7 |
| 88 | 1,768,168 | 258,368 | 228.5 | 201.7 |
| 89 | 1,767,416 | 257,823 | 229.5 | 199.5 |
| 90 | 1,766,548 | 257,326 | 230.3 | 195.3 |
| 97 | 1,765,104 | 256,218 | 233.2 | 199.2 |
| 114 | 1,763,511 | 255,138 | 240.1 | 201.1 |
| 115 | 1,762,976 | 253,813 | 241.5 | 226.0 |
| 116 | 1,762,331 | 252,494 | 235.8 | 173.8 |
| 164 | 1,769,065 | 258,995 | 228.0 | 206.9 |
| 165 | 1,767,861 | 259,062 | 246.7 | 207.0 |
| 166 | 1,768,595 | 258,008 | 234.7 | 211.2 |
| 167 | 1,767,568 | 257,089 | 244.5 | 207.8 |
| 168 | 1,765,185 | 255,445 | 268.3 | 192.3 |
| 169 | 1,766,083 | 256,601 | 233.4 | 195.5 |
| 170 | 1,765,389 | 257,018 | 233.1 | 200.6 |
| 171 | 1,765,641 | 257,772 | 241.7 | 220.3 |
| 172 | 1,763,146 | 255,952 | 231.1 | 205.8 |
| 173 | 1,763,998 | 256,721 | 236.0 | 222.7 |
| 174 | 1,762,614 | 254,807 | 243.8 | 206.9 |
| 175 | 1,762,305 | 253,898 | 241.1 | 232.1 |
| 176 | 1,761,814 | 253,036 | 239.8 | 219.5(234.5)* |
| 177 | 1,760,188 | 250,652 | 231.5 | 212.9 |
| 178 | 1,760,570 | 251,563 | 234.4 | 204.1 |
| 179 | 1,761,263 | 252,369 | 234.8 | 222.4 |
| 209 | 1,759,918 | 250,122 | 231.9 | 204.6 |
| 210 | 1,760,526 | 250,350 | 232.6 | 204.4 |
| 211 | 1,759,877 | 250,498 | 247.0 | 213.0 |
| 212 | 1,760,360 | 251,180 | 233.0 | 210.2 |
| 213 | 1,760,322 | 251,802 | 238.0 | 203.8 |
| 214 | 1,760,020 | 252.090 | 235.0 | 226.2 |
| 315 | 1,763,207 | 255,439 | 237.0 | 208.2 |
| 316 | 1,763,229 | 255,073 | 239.9 | 210.5 |
| 317 | 1,762,915 | 254,562 | 239.4 | 218.4 |
| 318 | 1,762,726 | 254,678 | 240.1 | 205.8 |
| 319 | 1,762,945 | 254,191 | 237.9 | 224.3(230.9)* |
| 320 | 1,762,631 | 253,680 | 237.1 | 222.5(232.6)* |
| 321 | 1,762,316 | 253,169 | 235.[illegible] | 198.5 |
| 322 | 1,762,128 | 253,285 | 238.2 | 232.4 |
| 323 | 1,761,782 | 253,146 | 234.6 | 223.9(240.3)* |
| 324 | 1,762,001 | 252,658 | 234.3 | 218.0 |
| 325 | 1,761,656 | 252,519 | 233.2 | 216.[illegible](229.5)* |
| 326 | 1,764,481 | 256,[illegible] | [illegible]0.1 | 224.1 |

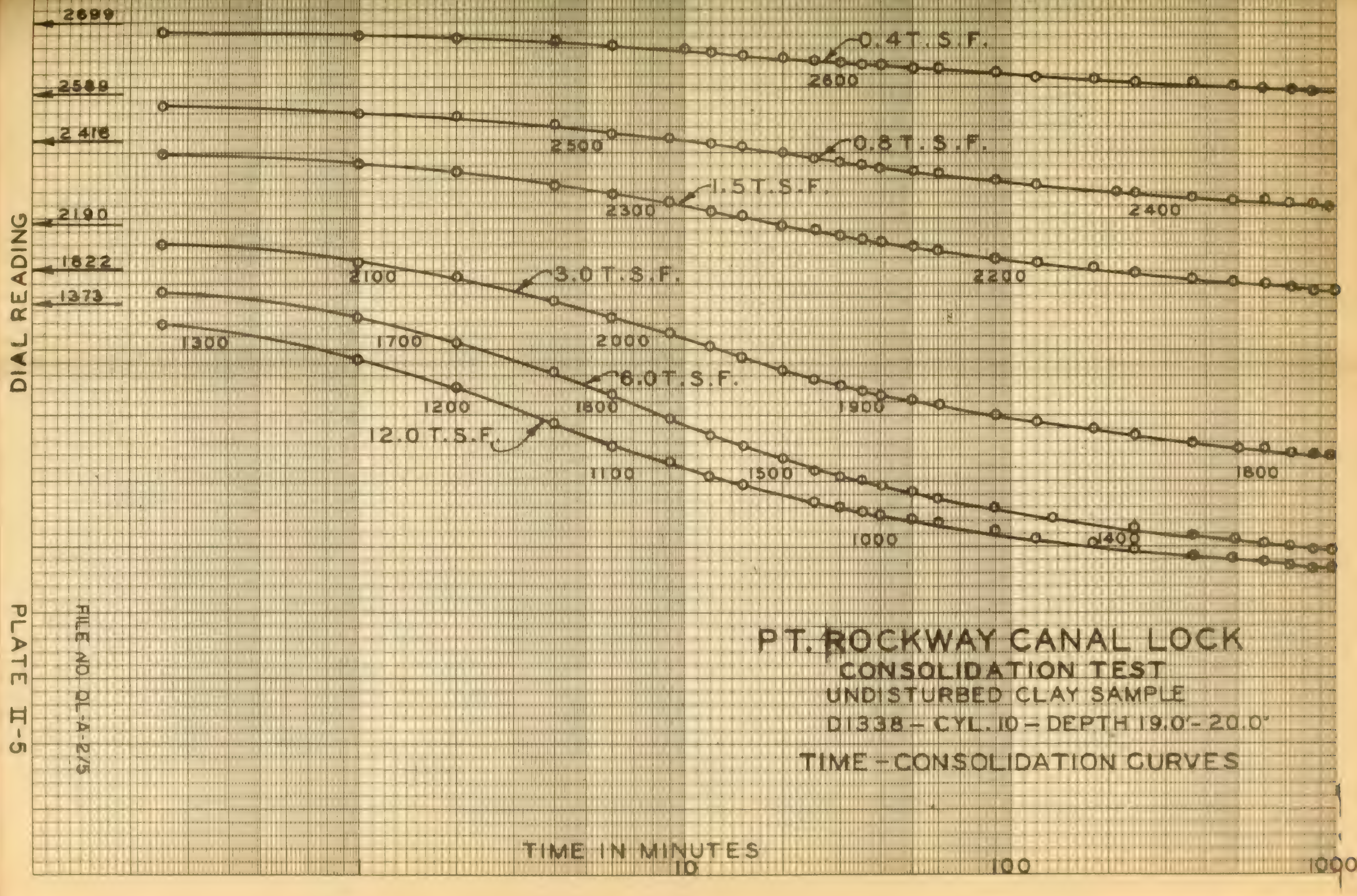
| Line No. | Mercator Coordinates N. | Mercator Coordinates E. | Surface elevation at center point | Rock Elevation |
|---|---|---|---|---|
| 327 | 1,764,058 | 255,800 | 238.8 | 230.2 |
| 328 | 1,763,953 | 255,995 | 233.6 | 223.1 |
| 329 | 1,763,848 | 256,190 | 233.3 | 217.0 |
| 330 | 1,764,5[illegible]6 | 256,085 | 238.2 | 215.0 |
| 331 | 1,764,376 | 256,474 | 236.7 | 213.9 |
| 332 | 1,764,904 | 256,759 | 235.1 | 212.9 |
| 333 | 1,765,014 | 256,355 | 229.6 | 206.4 |
| 381 | 1,769,202 | 258,901 | 237.6 | 191.2 |
| 394 | 1,769,465 | 259,004 | 225.1 | 180.0 |

*Due to the overburden and bedrock conditions in this area, the interpretation of the seismic data is uncertain. Figures in parentheses are the probable surface elevation of slightly fractured and weathered bedrock. Figures not in parentheses are the probable elevation of sound bedrock.

CONSOLIDATION CHARACTERISTICS *ST. LAWRENCE RIVER*



FILE NO. QL-A-2/4 PLATE II-4



PT. ROCKWAY CANAL LOCK
CONSOLIDATION TEST
UNDISTURBED CLAY SAMPLE
D1338 – CYL. 10 – DEPTH 19.0′ – 20.0′

TIME – CONSOLIDATION CURVES

FILE NO. DL-A-2/5

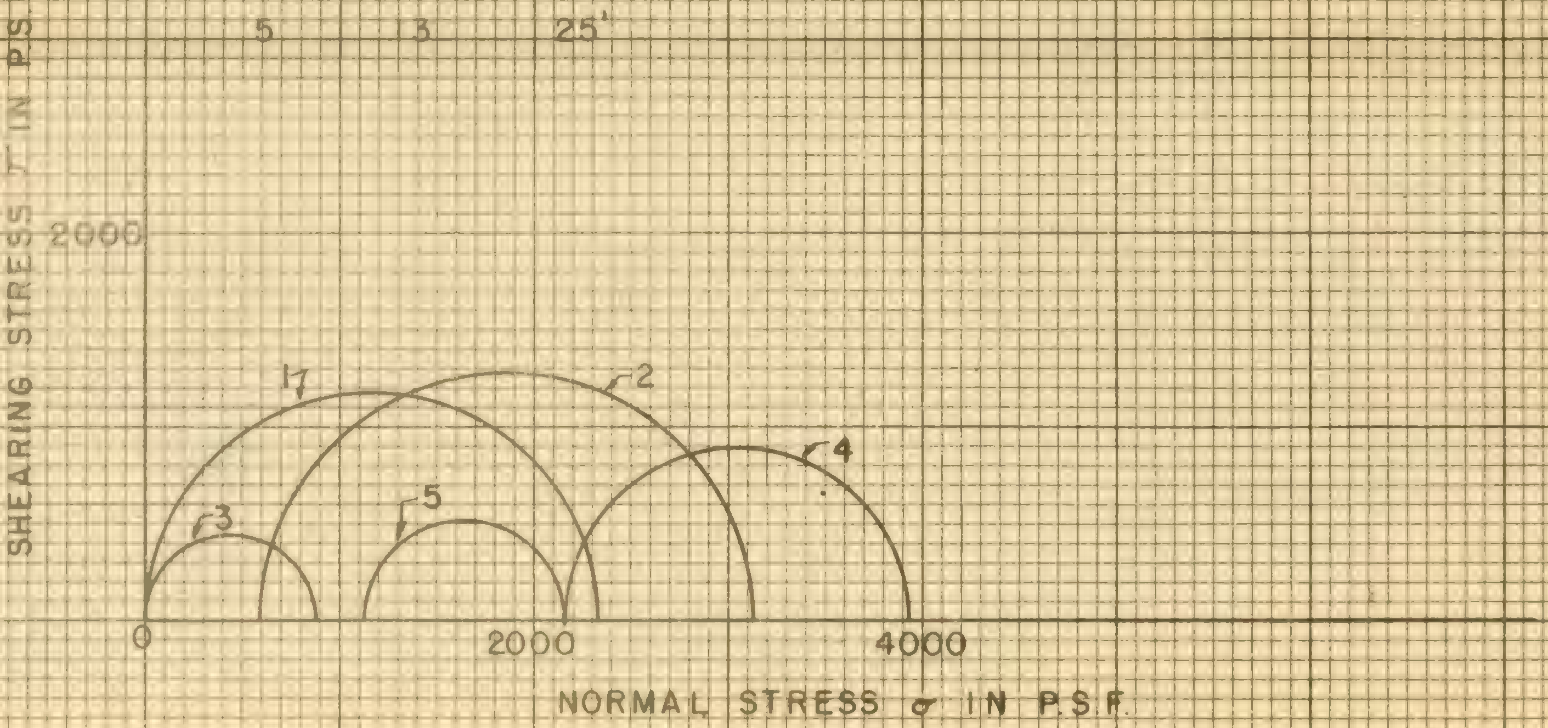
PLATE II-5

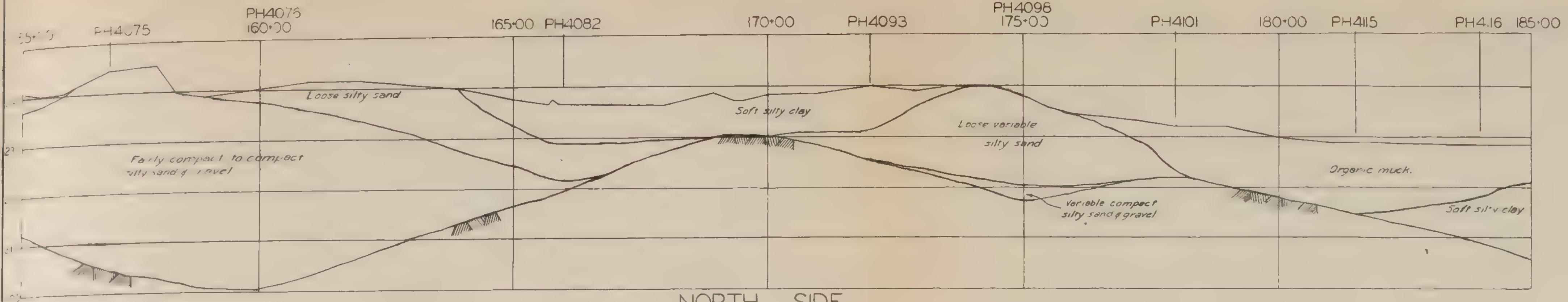
# TRIAXIAL SHEAR TESTS
## QUICK SHEAR
## UNDISTURBED CLAY SAMPLES

DRILL HOLE D1338
POINT ROCKWAY CANAL LOCK

All tests run on samples 2.8" dia X 5.6" long

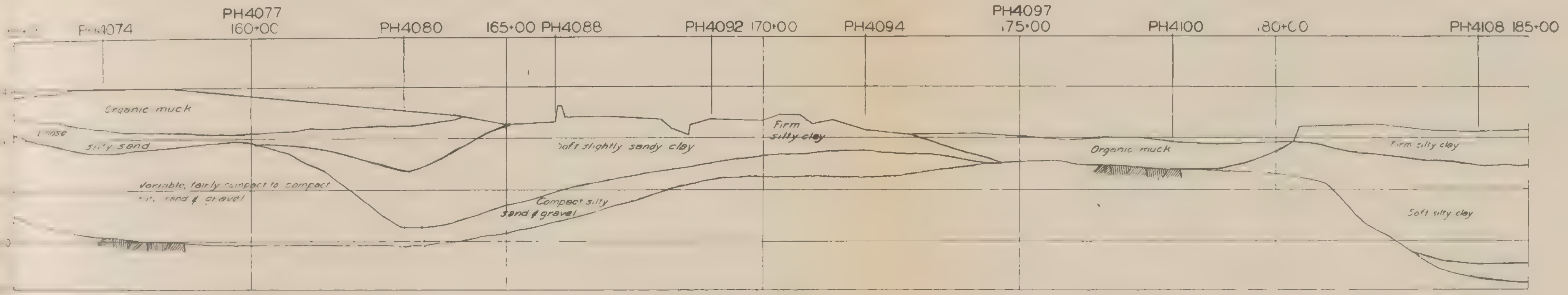
| NO. | CYL. NO. | DEPTH |
|---|---|---|
| 1 | 6 | 13' |
| 2 | 6 | 13' |
| 3 | 7 | 14.5' |
| 4 | 10 | 19.5' |
| 5 | 13 | 25' |



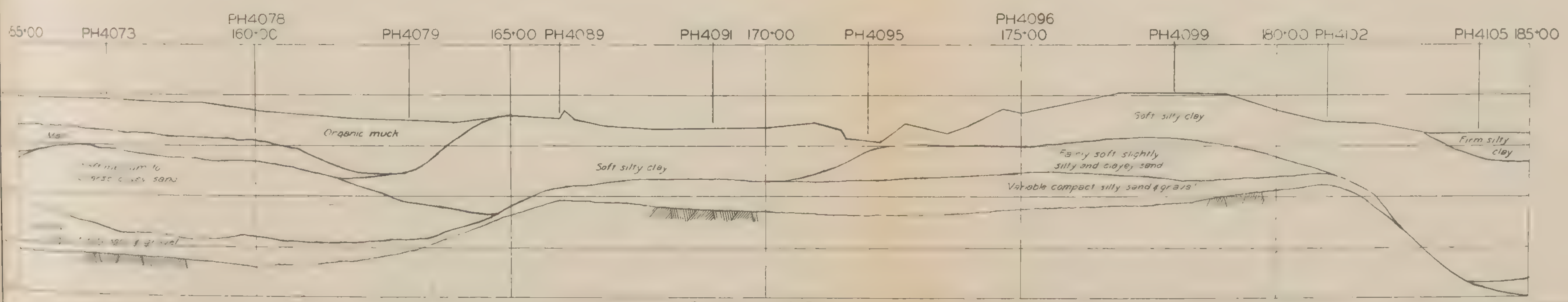


NORTH SIDE

221 NORTH



CENTER LINE



SOUTH SIDE

221 SOUTH

ST. LAWRENCE RIVER PROJECT
POINT ROCKWAY LOCK
**GEOLOGICAL PROFILES**
STA 155+00 TO STA 185+00

IN SHEETS SHEET NO SCALE AS SHOWN

100 0 100 200

U S ENGINEER OFFICE, MASSENA, NEW YORK

SUBMITTED A. Butterfield Jr. ASST ENGINEER

RECOMMENDED HEAD ENGR LIEUT. CORPS OF ENGINEERS

APPROVED LT. COL. CORPS OF ENGINEERS DISTRICT ENGINEER

DRAWN BY

CHECKED BY M.S.V.

FILE NO QL-A-2/7

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DATED

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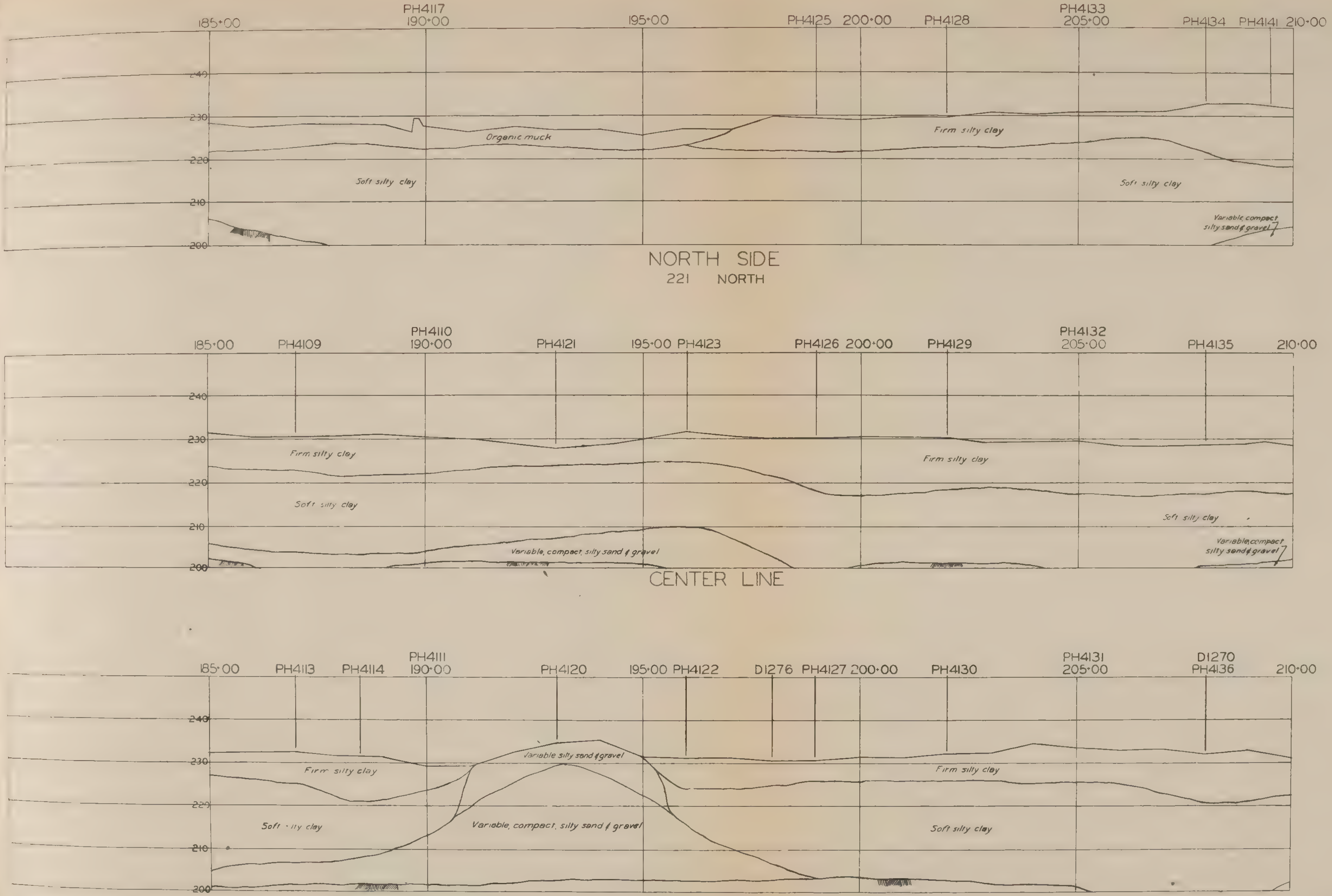
CORPS OF ENGINEERS, U. S. ARMY



SOUTH SIDE
221' SOUTH

ST. LAWRENCE RIVER PROJECT
POINT ROCKWAY LOCK
**GEOLOGICAL PROFILES**
STA 185+00 TO STA 210+00

IN SHEETS SHEET NO SCALE AS SHOWN

00 0 100 200

U S ENGINEER OFFICE, MASSENA, NEW YORK FEB 1942

| SUBMITTED | RECOMMENDED | APPROVED |
|---|---|---|
| G. Butterfield, Jr.<br>ASST ENGINEER | HEAD ENGR<br>LOCAL CORPS OF ENGINEERS | COL. CORPS OF ENGINEERS<br>DISTRICT ENGINEER |

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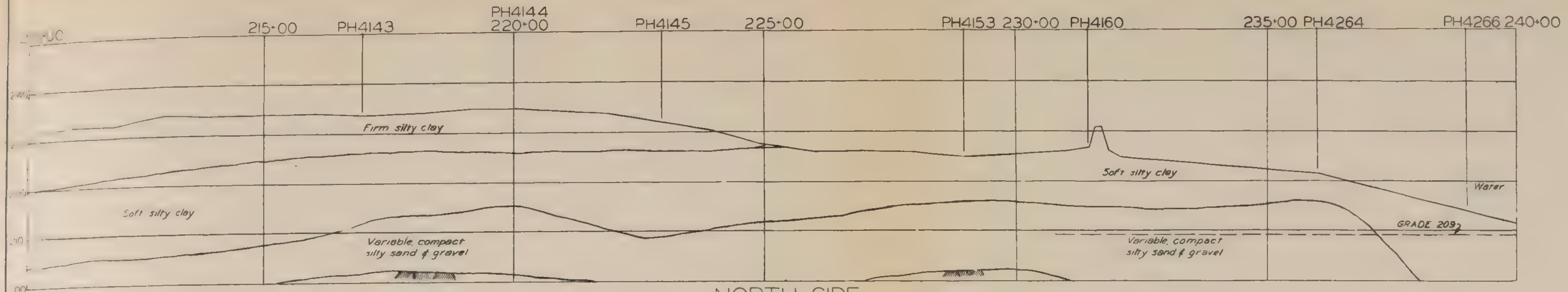
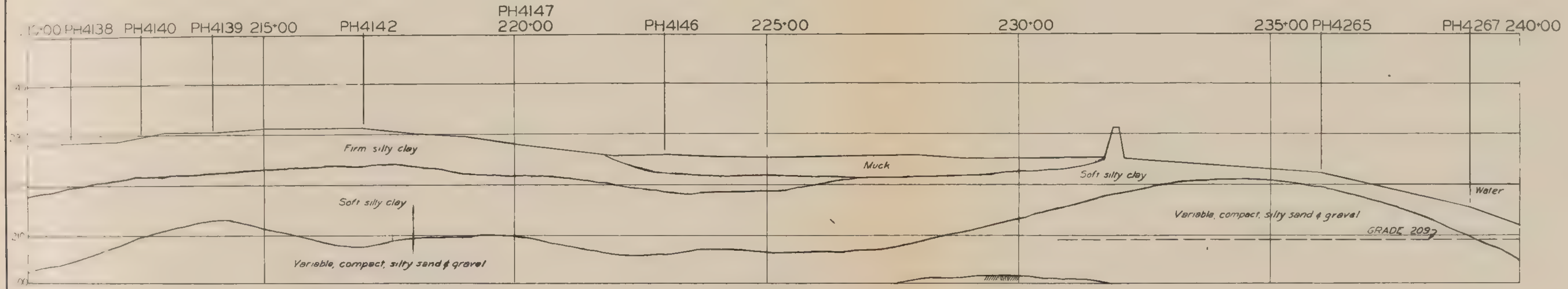
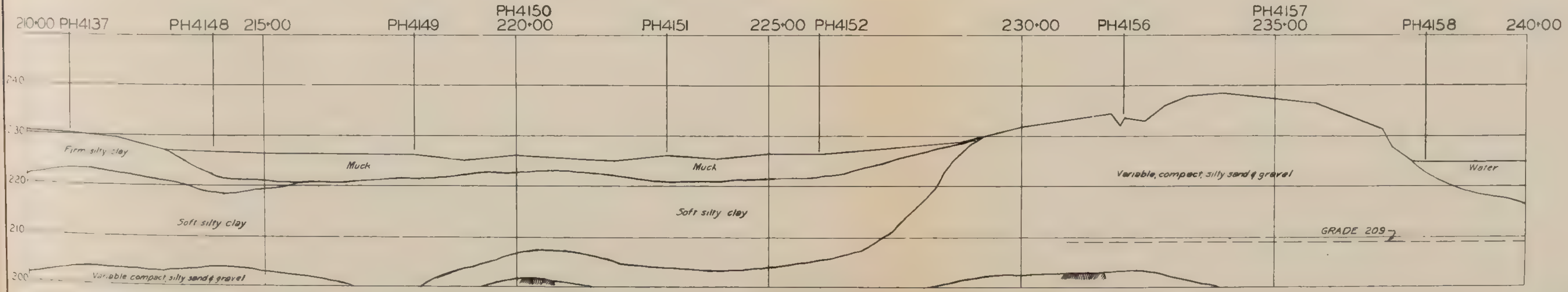


NORTH SIDE
221' NORTH



CENTER LINE



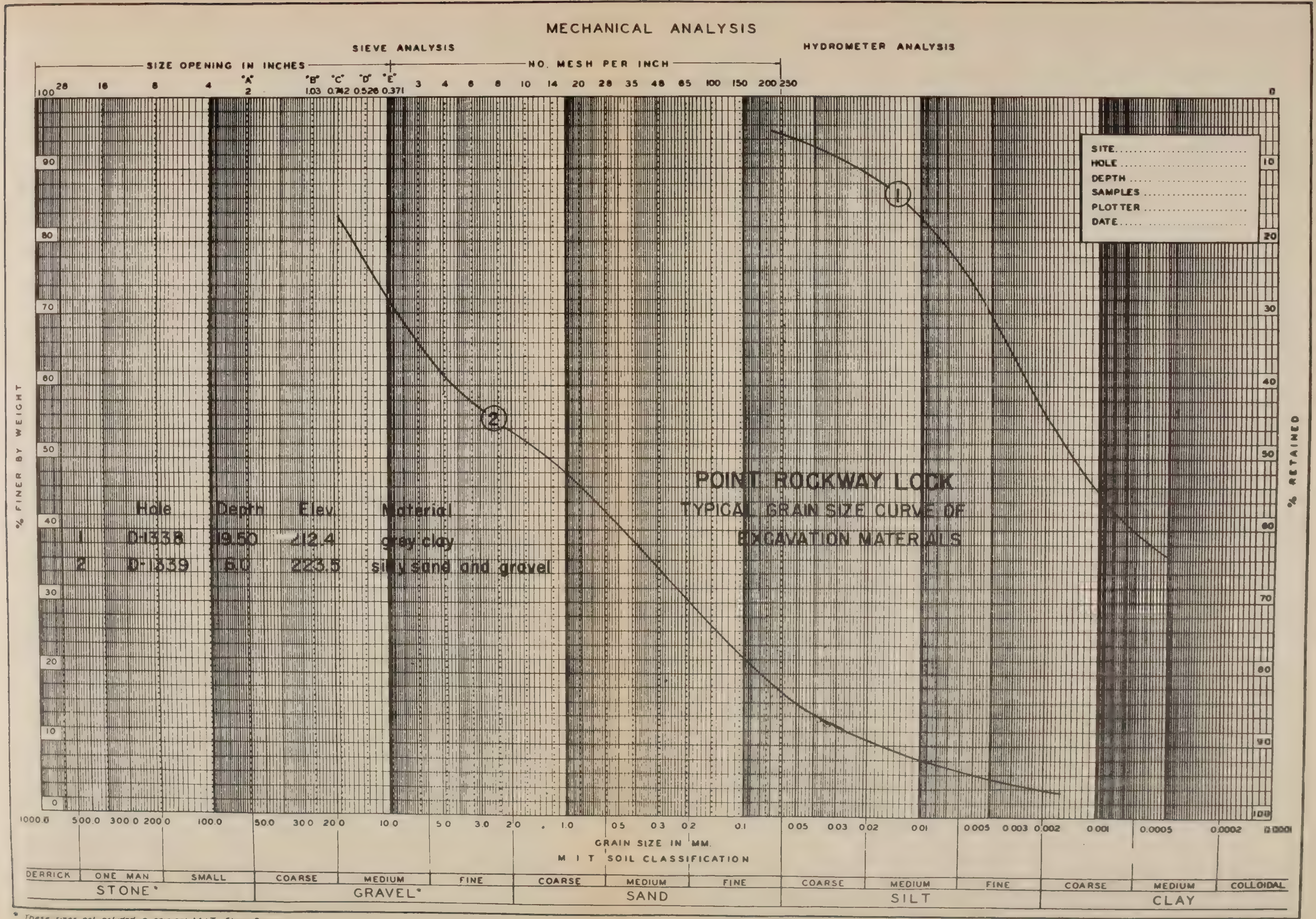
SOUTH SIDE
221' SOUTH

**ST. LAWRENCE RIVER PROJECT**
POINT ROCKWAY LOCK
**GEOLOGICAL PROFILES**
STA 210+00 TO STA. 240+00

IN SHEETS SHEET NO SCALE AS SHOWN
100 0 100 200

U. S. ENGINEER OFFICE, MASSENA, NEW YORK FEB. 1942

SUBMITTED C.R. Butterfield, Jr. ASST. ENGINEER
RECOMMENDED HEAD ENGR LIEUT. COL. CORPS OF ENGINEERS
APPROVED COL. CORPS OF ENGINEERS DISTRICT ENGINEER
DRAWN BY R.L.M.
CHECKED BY M.J.V.
FILE NO QL-A-2/9
TRANSMITTED WITH LETTER OR ENDORSEMENT
DATED



POINT ROCKWAY LOCK
TYPICAL GRAIN SIZE CURVE OF
EXCAVATION MATERIALS

| | Hole | Depth | Elev. | Material |
|---|---|---|---|---|
| 1 | D-1338 | 19.50 | 212.4 | grey clay |
| 2 | D-1339 | 16.0 | 223.5 | silty sand and gravel |

* These sizes not included in original M I T Classification

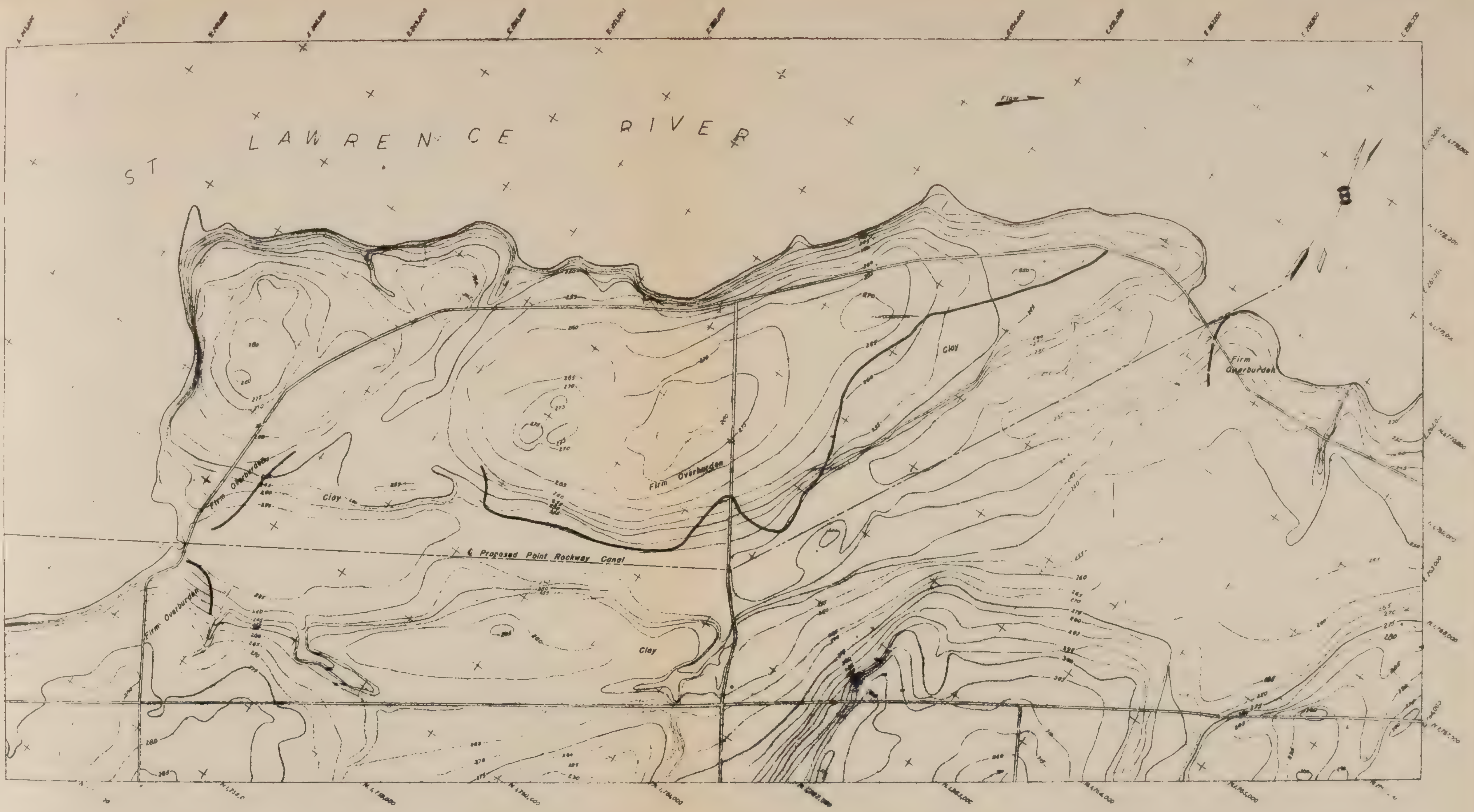
FILE NO. QL-A-2/10

PLATE III-4

SL-5.00

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



ST LAWRENCE RIVER PROJECT

## POINT ROCKWAY CANAL

## SOILS CONDITION IN VICINITY OF SPOIL AREAS

SOILS & FOUNDATION EXPLORATION

IN SHEETS SHEET NO SCALE

U.S. ENGINEER OFFICE, MASSENA, NEW YORK FEBRUARY, 1942

SUBMITTED R. M. Hou[illegible]

RECOMMENDED LT. COL. CORPS OF ENGINEERS

APPROVED

DRAWN BY

CHECKED BY

FILE NO QL-A-2/11

Pl. III-5

# PART TWO

# POINT ROCKWAY LOCK

## ESTIMATE OF COST

## COST ESTIMATE

### Feature No. 8 - Point Rockway Lock and Attached Dikes

### A. INITIAL CONTRACT ITEMS OF WORK.

| tem No. | Quantity | Unit | Designation | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | 3,138,000 | C.Y. | Excavation, Common | $ 0.26 | $ 815,880 |
| 2 | 450,000 | C.Y. | Excavation, Borrow | 0.30 | 135,000 |
| 3 | 516,000 | C.Y. | Excavation, Rock | 1.80 | 928,800 |
| 4 | 67,000 | C.Y. | Earth Fill, Compacted, Class I | 0.12 | 8,040 |
| 5 | 675,000 | C.Y. | Earth Fill, Compacted, Class II | 0.10 | 67,500 |
| 6 | 21,000 | S.F. | Line Drilling | 1.00 | 21,000 |
| 7 | None | C.Y. | Filter | - | - |
| 8 | 6,900 | C.Y. | Sand and Gravel Backing | 1.75 | 12,075 |
| 9 | 19,100 | C.Y. | Riprap; Dumped, Class "A" | 2.00 | 38,200 |
| 0 | 29,900 | C.Y. | Riprap; Dumped, Class "B" | 1.50 | 44,850 |
| 1 | 1,100 | L.F. | Drilling; Grout Holes in Concrete | 2.50 | 2,750 |
| 2 | 2,400 | L.F. | Drilling; Grout Holes in Rock, 0 to 25 ft. | 4.00 | 9,600 |
| 3 | 750 | L.F. | Drilling; Grout Holes in Rock, 25 ft. and over | 4.50 | 3,375 |
| 4 | 1,800 | L.F. | Drilling; Exploratory Holes in Rock, 0 to 25 ft. | 4.00 | 7,200 |
| 5 | 400 | L.F. | Drilling; Exploratory Holes in Rock, 25 to 50 ft. | 4.50 | 1,800 |
| 6 | 400 | L.F. | Drilling; Exploratory Holes in Rock, 50 to 100 ft. | 5.00 | 2,000 |
| 7 | 4,000 | C.F. | Pressure Grouting | 1.00 | 4,000 |
| 8 | 300 | C.F. | Sand in Grout | 0.25 | 75 |
| 9 | 300 | C.F. | Rock Flour in Grout | 0.50 | 150 |
| 0 | 34.5 | MBM | Timber, White Oak | 250.00 | 8,625 |
| 1 | 15.1 | MBM | Timber, Common(Creosoted) | 175.00 | 2,643 |
| 2 | 1,050 | C.Y. | Concrete, Class "A" (incl.aggregates) | 16.00 | 16,800 |
| 3 | 271,500 | C.Y. | Concrete, Class "B" (incl. aggregates | 7.00 | 1,900,500 |
| 4 | 2,416,000 | lb. | Steel; Structural, Sector Gates, movable parts | 0.11 | 265,760 |
| 5 | 6,500 | S.F. | Floor Plating, Steel | 1.10 | 7,150 |
| 6 | 1,104,000 | lb. | Steel; Structural, Stop Logs | 0.08 | 88,320 |
| 7 | 685,000 | lb. | Steel; Structural, Miscellaneous | 0.18 | 123,300 |
| 8 | 600,000 | lb. | Steel Erection; Concrete reinforcement | 0.025 | 15,000 |
| 9 | 90,000 | lb. | Forgings, Steel | 0.30 | 27,000 |
| 0 | 220,000 | lb. | Castings, Steel | 0.25 | 55,000 |
| 1 | 13,000 | lb. | Castings, Alloy steel (incl. nickel steel) | 0.50 | 6,500 |
| 2 | 70,000 | lb. | Castings, Iron | 0.16 | 11,200 |
| 3 | 11,000 | lb. | Brass and Bronze | 1.00 | 11,000 |
| 4 | None | lb. | Miscellaneous Non-ferrous metals | - | - |
| 5 | 2,400 | L.F. | Pipe; Steel, black, 12" diameter | 7.45 | 17,880 |
| 6 | 700 | L.F. | Pipe; Steel, black, 6" diameter | 2,85 | 1,995 |
| 7 | 400 | L.F. | Pipe; steel, black, 4" diameter | 1.60 | 640 |

| tem No. | Quantity | Unit | Designation | Unit Price | Amount |
|---|---|---|---|---|---|
| 8 | 17,000 | L.F. | Conduit; Fiber, 3" diameter | 0.35 | 5,950 |
| 9 | 1,400 | L.F. | Conduit; Rigid Metal, 2" diameter | 1.00 | 1,400 |
| 0 | job | sum | Electrical Ground System | | 650 |
| 1 | 2,300 | L.F. | Handrailing; steel pipe | 3.00 | 6,900 |
| 2 | 7,200 | lb. | Rubber Seals, moulded | 0.75 | 5,400 |
| 3 | 28,000 | lb. | Corrugated Sheet; Iron | 0.15 | 4,200 |
| 4 | 28 | L.F. | Tile Gages | 6.00 | 168 |
| 5 | 250 | Each | Core Boxes | 2.00 | 500 |
| 6 | job | sum | Stiff-leg Derricks and Machinery | | 34,000 |
| 7 | 25,200 | lb. | Pick-up Boom; 2 at12,600# | 0.16 | 4,032 |
| 8 | 218,600 | lb. | Machinery; Sector Gates, furnished installed, 8 sets | 0.45 | 98,370 |
| 9 | 8 | Set | Motors, Brakes and Limit Switches; for Sector Gates, furnished and installed | 1750.00 | 14,000 |
| 0 | 31,300 | lb. | Fender Boom | 0.15 | 4,695 |
| 1 | 511,200 | lb. | Machinery, Wire Rope Fenders, installed only, 4 sets | 0.05 | 25,560 |
| 2 | 4 | sets | Motors, Brakes and Limit Switches; for wire rope fenders, installed only | 300.00 | 1,200 |
| 3 | 300 | CWT (100lb) | Counterweight | 3.00 | 900 |
| 4 | Job | sum | Swing Bridge and machinery, complete | | 213,000 |
| 5 | Job | sum | Lock Unwatering Pumps and Sump Pumps | | 29,000 |
| 6 | Job | sum | Field Office | | 6,500 |
| 7 | Job | sum | Field Office Extension | | 3,100 |
| 8 | 7.5 | acre | Seeding | 250.00 | 1,875 |
| 9 | 100,000 | Sq. (100sf) | Rolling for each additional Two Trips | 0.02 | 2,000 |
| 0 | 3,600 | C.Y. | Gravel Fill Base | 1.80 | 6,480 |
| 1 | 14,200 | S.Y. | Road Surfacing | 1.60 | 22,720 |
| 2 | 3,900 | L.F. | Highway Guard Rail | 1.25 | 4,875 |
| 3 | 40 | L.F. | Pipe; Corrugated Iron, 24" diameter | 4.50 | 180 |
| 4 | 300 | each | Pressure Test, Grout Holes | 1.50 | 450 |

SUB-TOTAL $5,159,713

General Overhead, Engineering, Omissions and Contingencies at 18% = 929,217

TOTAL Initial Contract Cost = 6,088,930

B. MATERIALS FURNISHED BY THE GOVERNMENT

| | | | |
|---|---|---|---|
| Cement - 323,000 bbls. at | | 2.50 | 812,500 |
| Steel; concrete reinforcement - 600,000 lbs. at | | 0.04 | 24,000 |
| SUB-TOTAL | | | $ 836,500 |
| General Overhead, Engineering, Omissions and Contingencies at 18% | | | 150,570 |
| TOTAL COST, Materials furnished by Government | | | $ 987,070 |

C. FUTURE CONTRACT WORK

| | | | |
|---|---|---|---|
| Electrical Lighting, Power and Central System- | sum | | $ 90,000 |
| Operations Building Superstructure - | sum | | 30,000 |
| Buildings and Grounds - | sum | | 100,000 |
| | | | $ 220,000 |
| General Overhead, Engineering, Omissions, and Contingencies at 25% | | | 55,000 |
| TOTAL future contract costs | | | $ 275,000 |

TOTAL COST, POINT ROCKWAY LOCK AND ATTACHED DIKES $7,351,000

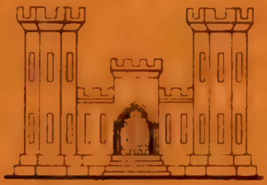
# ST. LAWRENCE RIVER PROJECT

## FINAL REPORT

## 1942

# MASSENA CANAL INTAKE WORKS

## SPECIFICATIONS



DOCUMENTS Room 8

CORPS OF ENGINEERS, U.S. ARMY

U.S. ENGINEER OFFICE · MASSENA, NEW YORK.

APPENDIX III-15 (2)

# ST. LAWRENCE RIVER

# PROJECT

* * * * *

## FINAL REPORT

1942

## MASSENA CANAL
## INTAKE WORKS

## SPECIFICATIONS

CORPS OF ENGINEERS, U.S. ARMY

U.S. Engineer Office - Massena, New York

July , 1942

Massena Canal Intake Works Invitation No.______

No. ________ Bidder________________________________________

(Do not write above this line)

# STANDARD GOVERNMENT FORM OF INVITATION FOR BIDS

# (CONSTRUCTION CONTRACT)

WAR DEPARTMENT
UNITED STATES ENGINEER OFFICE
MASSENA, NEW YORK
________, 1942

1. SEALED BIDS, in duplicate, subject to the conditions contained herein, will be received until 2:00 pm. E.S.T., ________ and then publicly opened in the United States Engineer Office, Massena, New York, for furnishing all labor, plant, and materials, and performing all work for the construction of the Massena Canal Intake Works, about 3 miles northwest of the village of Massena, New York, all as indicated on the drawings or required by the specifications.

2. SPECIFICATIONS AND PLANS.

(a) The work shall be done in strict accordance with the specifications and drawings which are designated as follows:

(1) Massens Canal Intake Works

(2) The drawings which will become a part of this contract are designated in paragraph 1-04 of the specifications.

(b) Where copies of drawings are requested, a deposit of twenty-five dollars ($25.00) will be required to insure their return. The deposit should be in the form of a United States money order or a certified check made payable to "The Treasurer of the United States." The deposit will be refunded upon the return of the plans in good condition within 30 days after date of opening bids.

3. INVESTIGATION OF CONDITIONS. - Bidders are expected to visit the locality and site of the work, and to make their own estimates of the facilites needed, and the difficulties attending the execution of the proposed contract, including local conditions, availability of labor, uncertainty of weather, and other contingencies. In no case will the Government assume any responsibility whatever for any interpretation, deduction, or conclusion drawn from the examination of the site. At the bidder's request, a representative of the Government will point out the site of the proposed operation. Failure to acquaint himself with all available information concerning these conditions will not relieve the succeesful bidder of assuming all responsibilities for estimating the difficulties, and costs of successfully performing and completing the work. (See paragraphs 1-18 and 1-19 of the specifications.)

4. WAGE AND LABOR PROVISIONS.- Wage, labor, and anti-discrimination regulations are specified in paragraph 1-38 of the specifications and Articles 11 (Revised), 17, and 19 (Revised) of the contract. Attention of bidders is invited to War Department labor policy for defense construction projects set

out in memorandum of agreement approved July 22, 1941. Successful bidders will be expected to adhere to provisions of the agreement, copies of which are on file at the office of District Engineer, U. S. Engineer Office, Massena, N. Y.

5. DOMESTIC PREFERENCE. - Articles on the preference for domestic articles will be made a part of the contract. (See paragraph 1-35 of the specifications.)

6. ARTICLES ON PATENTS will be made a part of the contract. (See paragraph 1-30 of the specifications.)

7. COMMENCEMENT AND COMPLETION. - The work shall be commenced within _____ calendar days after date of receipt of notice to proceed and shall be completed in accordance with the provisions of paragraph 1-06 of the specifications.

8. EXTENSION OF TIME FOR COMPLETION OF CONSTRUCTION FOR DELAYS DUE TO NATIONAL DEFENSE PRIORITIES will be made. (See paragraph 1-06(e) of the specifications.)

9. LIQUIDATED DAMAGES for delay will be prescribed. (See paragraph 1-06 of the specifications).

10. PARTIAL PAYMENTS will be made. (See paragraph 1-08 of the specifications and article 16 of the contract.)

11. ADJUSTMENT OF CONTRACT PRICE by reason of change in Federal, State and local taxes will be made. (See paragraph 1-42 of the specifications.)

12. ADJUSTMENT OF PRICES FOR LABOR AND MATERIALS. Adjustment of prices in accordance with basic increase or decrease of costs of labor and material will be made as provided in para. 1-46 of the specifications.

13. ESTIMATES OF COST.- Bidders are informed that the Government will prepare estimates of the cost of construction of the work required by the specifications for comparison of bids.

14. REPORTS TO THE DEPARTMENT OF LABOR. In order to assis the Department of labor in obtaining employment statistics, bidders, unless otherwise indicated in their bids, will be considered as having voluntarily consented, without cost to the Government, to the inclusion of paragraph 1-39 of the specifications as a part of the contract.

15, BID AND CONTRACT.

(a) Bids must be submitted upon the standard Government form of bid, and the successful bidder will be required to execute the standard Government form of contract for construction (U. S. Standard Form No. 23). Bidders are advised that Article 11 (a) of U. S. Standard Form No. 23 has been revised to permit laborers and mechanics to work more than 8 hours per day, provided overtime compensation at a rate of not less than 1-1/2 times the basic rate of pay is paid for all working time of each laborer or mechanic in excess of 8 hours in any one day. Also Article 19, Nonrebate of U. S. Standard Form No. 24, is revised to read as follows, and the contract to be entered into as a result of this invitation will be altered accordingly:

"ARTICLE 19. NONREBATE. (a) The contractor shall furnish to the Government representative in charge at the site of the work covered by this contract, or if no Government representative is in charge at the site, shall mail to the Federal agency contracting for the work, within 7 days after the regular payment date of each and every weekly pay roll, an affidavit in the form prescribed by regulations issued by the Secretary of Labor and published in the Federal Register of March 1, 1941, 6 F. R. 1211, or any modification thereof pursuant to the act of June 13, 1934, 48 Stat. 984 (U. S. Code title 40, sections 276b and 276c), sworn to by the contractor or the subcontractor concerned or by the authorized officer or employee of the contractor or subcontractor supervising such payment, to the effect that each and every person employed on the work has been paid in full the weekly wages shown on the pay roll covered by the afidavit, that no rebates have been or will be made either directly or indirectly to or on behalf of the contractor or such subcontractor from the full weekly wages earned as set out on such payroll; and that no deductions, other than permissible deductions as defined in the said regulations pursuant to said act of June 13, 1934, and as described in said affidavit, have been or will be made, either directly or indirectly, from the full weekly wages earned as set out on such pay roll.

"(b) The contractor shall comply with all applicable requirements of the said regulations of the Secretary of Labor under the act of June 13, 1934, and the requirements of this article of the contract shall be subject to all applicable provisions of such regulations.

"(c) The contractor shall cause appropriate provisions to be inserted in all subcontracts relating to this work to insure fulfillment of the requirements of this article."

"(b) The bid form has an entry for each item on which estimates will be given or payments made, and no other allowance of any kind will be made unless specifically provided for in the specifications or the contract, or adjustments under Article 3 of the contract.

"(c) All bids must be for the entire work and must have each blank filled.

(d) The quantities of each item of the bid as finally ascertained at the close of the contract, in the units given, and the unit price of the several items stated by the bidder in the accepted bid, will determine the total payments to accrue under the contract. The unit price bid for each item must allow for all collateral or indirect cost connected with it.

## 16. DATA TO BE SUBMITTED WITH BIDS.

(a) All bids submitted must be accompanied by a statement establishing that the bidder maintains a permanent place of business and has a suitable financial status to meet obligations incident to the work. (See paragraph 3 of the bidding schedule.) In addition, each bidder shall submit with hsi bid the statement of plant, drawings, charts, and other information and data required below. These data shall be carefully prepared and presented in neat and legible form on tracing paper or tracing cloth so that reproduction may be made therefrom. These data are considered essential in enabling the contracting officer to determine whether the bidder is responsible and experienced in similar types of construction and whether the bid is based on a careful study of construction methods applicable to the work and full realization of the various factors which may affect the progress of the work. Award of this contract shall not be construed as a guarantee by the Government that the materials or supplies listed in the bidding schedule are approved.

(b) Each bidder shall state in the space provided in the bidding schedule a brief description of the character of the work previously executed by him and the locations of the major projects. After the bids are opened, any bidder may be required by the contracting officer to state whether he is now or ever has been engaged on any construction work similar to that proposed, the year in which it was done, and the manner of its execution, and to give such other information as will tend to show his ability to prosecute vigorously the work required by these specifications. (See paragraph 2 of the bidding schedule.)

(c) A complete list and description shall be inserted in the space provided therefor in the bid form, of all plant that the bidder now has or will available for commencing and prosecuting this work, and its location at the time of opening bids, in order that it may be inspected by the contracting officer should he so desire. The above information will be considered confidential. When a bidder does not own or possess plant and proposes to procure it, firm options on all major items of proposed plant must be submitted when the bids are opened.

(d) A chart or charts shall be submitted indicating the volume of work to be done and the rate of progress which the bidder agrees to maintain for each of the following major operations required in the performance of the work under these specifications:

(1) Excavation and Foundation Preparation
(2) Concrete Masonry
(3) Cofferdams
(4) Embankment
(5) Gantry Crane
(6) Gate Installation

Charts shall be in the form of plotted curves in which the abscissae shall represent definite intervals of time measured from date of receipt of notice to proceed with the work, and the ordinates shall represent percentages of completion based on the estimated contract quantities. In preparing these charts, due allowance shall be made for probable delays caused by any unsatisfactory working conditions. Careful consideration shall be given to the preparation of these charts, as the rate of progress proposed by the accepted bid will be made a part of the contract. (See paragraph 1-20 of the specifications.)

## 17. AWARD OF CONTRACT.

(a) Subject to the rights hereinafter reserved, work will be awarded as a whole to the lowest responsible bidder whose proposal fully conforms to the requirements of the specifications and as may be deemed most advantageous to the United States.

(b) A bid may be rejected if the bidder fails to furnish bid bond or to submit the data required with his bid or cannot show that he has the necessary capital and experience and owns, controls, or can procure the necessary plant to commence the work at the time prescribed in the specifications and thereafter to prosecute and complete the work at the rate or time specified; and that he is not already obligated for the performance of other work which would delay the commencement, prosecution, or completion of the work contemplated in this advertisement.

(c) Any unbalanced bid which, in the opinion of the contracting officer, jeopardizes the interest of the United States will be subject to rejection for that reason.

(d) The right is reserved, as the interest of the Government may require, to reject any and all bids and to waive any informality in bids received.

18. GUARANTY.- Guaranty will be required with each bid as follows: Bid Bond, Standard Form No. 24, will be executed in a penal sum not less than 10 percent of the total amount of the bid, but not exceeding $2,500,000. Individual sureties will justify in sums aggregating not less than double the penalty of the bid bond. (See paragraphs 8 and 9 of the Instructions to Bidders.)

19. PERFORMANCE AND PAYMENT BONDS will be required as follows:

(a) A performance bond with good and sufficient surety or sureties, for the protection of the United States, Standard Form No. 25, will be executed in a penal sum not less than ten percent (10%) of the full amount of the consideration of the contract, but not exceeding $2,500,000.

(b) If the consideration of the contract will exceed $2,000 in amount, a payment bond with good and sufficient surety or sureties, for the protection of persons furnishing material and labor for the work, Standard Form No. 25-A, will be executed in a penal sum of one-half of the full amount of the consideration of the contract when the latter is not more than one million dollars ($1,000,000); forty percent (40%) where the contract exceeds one million dollars ($1,000,000), but is not more than five million dollars ($5,000,000); and two million five hundred thousand dollars ($2,500,00) for all contracts above five million dollars ($5,000,000).

20. PROVISIONS OF THE ASSIGNMENT OF CLAIMS ACT of October 9, 1940, (Public No. 811-76th Congress) will be made a part of the contract. (See paragraph 1-45 of the specifications.)

21. ADDRESS FOR BIDS. - Envelopes containing bids must be sealed, marked, and addressed as follows:

| Mark in upper left hand corner: | Address: |
|---|---|
| Bid for Construction of<br>Massena Canal Intake Works | To: The District Engineer<br>U. S. Engineer Office<br>Massena, New York |

Invitation No. ________
To be opened at 2:00 p.m., E.S.T.

---

Note: See Standard Government Instructions to Bidders and copy of the Standard Government Form of Contract, Bid Bond, Payment Bond, and Performance Bond, which may be obtained upon application.

Specifications: Massena Canal Intake Works

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WAR DEPARTMENT
U. S. Engineer Office
St. Lawrence River District
Massena, N. Y.

Specifications: Massena Canal Intake Works

Appropriation:

## SECTION I - GENERAL PROVISIONS

1-01. LOCATION. - The site of the work is located in the International Rapids Section of the St. Lawrence River, about 3 miles northwest of the village of Massena, New York, at the intake of the present Massena Power Canal. The site may be reached by Federal and State Highways on the United States side of the St. Lawrence River. For transportation facilities see Paragraph 1-19.

1-02. WORK TO BE DONE.

(a) The work provided herein is authorized by ______________ Act, approved _________________, 194 .

(b) The work to be done under this contract and in accordance with these specifications consists of furnishing all plant, superintendence, labor and materials, except as noted in paragraph 1-10, and performing all work required for the construction of the Massena Canal Intake Works, except for specifically excepted items, with appurtenant works, complete in accordance with the drawings and these specifications. The main features of the work are as follows:

(1) Excavation outside of the existing canal for foundations of concrete structures, unwatering the area, preparing the foundation and grouting. (See Section III.)

(2) Construction of the concrete spillway, bulkheads and training walls, including placing of reinforcement, embedded metal parts, and other appurtenant work.

(3) Excavation of the canal from the St. Lawrence River to the existing canal below the site of the new earth wing dam, and operation of stop logs in the spillway structure to control the flow of water into the canal. (See paragraph 1-12)

(4) Construction of rock and earth cofferdams across the existing canal, unwatering the area, and construction of rolled earth-fill wing dams north and south of the concrete structure, including stripping, excavation of core trenches, grouting where required, and preparation of the foundation. (See Sections II, III and IV)

(5) Erection and installation of eight vertical-lift control gates, complete with fixed hoists, under the supervision of erection engineers furnished and paid for by the gate and hoist manufacturers. (See Section VII)

(6) Erection and installation of the gantry crane under the supervision of an erection engineer furnished and paid for by the crane manufacturer. (See Section VII)

(7) Miscellaneous items including embedded electrical conduit system, ventilating systems in the electrical bay and the repair bay, air bubbler system, and other work as specified or shown on the drawings, and such incidental work as may be needed or ordered in writing by the contracting officer.

### 1-03. DESCRIPTION.

(a) Massena Canal Intake Works will be a concrete and earth structure having a maximum height of approximately 100 feet above foundation. It will have a reinforced concrete spillway flanked by concrete gravity bulkhead sections and earth wing dams. The spillway will be provided with eight submerged vertical-lift control gates of the tractor type, stilling basins, and training walls. The length of the spillway section will be 270 feet. The concrete bulkhead section on each end of the spillway will be 186 feet in length, exclusive of cut-off walls extending into the earth wing dams. The vertical-lift gates will be operated by individual fixed hoists; each gate closing an opening with a clear width of 9 feet and a clear height of 14 feet. Stop log guides are provided upstream and downstream to permit unwatering a gate chamber. A traveling gantry crane will provide means for removing the gates from their slots for handling the upstream stop logs, and for miscellaneous service on the dams. The wing dams will be of rolled earth protected on both sides with riprap, as shown on the drawings. The north wing dam will be approximately 1400 feet long and the south wing dam approximately 2200 feet long.

### 1-04. MAPS AND DRAWINGS.

(a) The work shall conform to maps and drawings marked "St. Lawrence River Project, Massena Canal Intake Works," titled and file marked as listed below, which form a part of these specifications and which are filed in the U. S. Engineer Office, St. Lawrence River District, Massena, New York.

LIST OF DRAWINGS

MASSENA CANAL INTAKE WORKS

| Sheet No. | Title | File No. |
|---|---|---|
| | GENERAL | |
| 1 | Index Sheet | LW-1-o/1 |
| 2 | General Site Map | 1/1 |
| 3 | General Plan and Elevation | 1/2 |
| 4 | Plan - Soils and Foundation Exploration | 1/3 |
| 5 | Record of Exploration | 1/4 |
| | EXCAVATION | |
| 6 | Excavation - Sheet 1 | LW-1-10/1 |
| 7 | Excavation - Sheet 2 | 10/2 |
| Sheet No. | Title | File No. |
| | MASONRY | |
| 8 | North and South Bulkheads | LW-1-15/1 |
| 9 | Spillway Plans and Sections | 15/2 |
| 10 | Miscellaneous Details | 15/3 |

| Sheet No. | Title | File No. |
|---|---|---|
| | EMBANKMENT | |
| 11 | Wing Dams | LW-1-20/1 |
| | GATES AND EQUIPMENT | |
| 12 | Upstream Stop Logs | LW-1-40/1 |
| 13 | Control Gates and Hoists | 40/2 |
| 14 | Control Gate Guides | 40/3 |
| 15 | Gantry Crane | 40/4 |

(b) These drawings show the work with as much detail as is possible in the present stage of development of the design. The work shall conform also to such other drawings and addenda relating thereto as may be published and/or exhibited in the office of the contracting officer prior to the opening of proposals, and to such drawings in explanation of details as may be required from time to time during construction, including such modifications as the contracting officer may consider necessary on account of conditions that are found to exist during the prosecution of the work. Detail bar lists and bending schedules for steel reinforcement will be furnished by the United States.

(c) Prior to the execution of the work the contractor shall check all drawings and shall immediately report to the contracting officer any errors or omissions discovered therin. Errors and/or omissions in drawings will not relieve the contractor of his responsibility for the correct fitting together and exact position of all parts of the work in accordance with the specifications. Parts and details not fully indicated on the drawings shall be detailed by the contractor in accordance with the best practice, or as directed by the contracting officer.

(d) The contractor shall submit fabricator's shop drawings of all structural steel and other metal work for approval. He shall also submit such shop drawings and material lists of all mechanical and electrical equipment as may be required by the contracting officer. No material shall be furnished or work done thereon prior to approval of these drawings. The contractor shall submit three (3) prints of each of such detailed drawings to the contracting officer who will return one print with his approval or notations of such changes as he finds necessary. Each print submitted for approval shall have in the lower right-hand corner just above the title a white space 3 inches by 4 inches in size in which the contracting officer will indicate the action taken. After approval, the contractor shall furnish the contracting officer one tracing and five prints of each approved drawing. Three copies or sets of parts catalogs, spare parts lists and operating instructions shall be furnished as specified above or as requested by the contracting officer. Payment for the contractor's drawings, including revisions thereof, parts catalogs, spare parts lists and operating instruction shall be included in the contract prices paid for material or work. All of these items will form a part of the contract when approved by the contracting officer.

(e) Ten sets of prints of necessary contract drawings (one-half size reproductions, or full size if desired) and twenty sets of specifications will be furnished the contractor without charge. Additional prints may be secured upon request at the cost of reproduction.

1-05. QUANTITIES. - The following estimate of quantities of work to be performed, as also shown in the "Schedule of Bid Items" under these specifications, is given only to serve as a basis for convassing bids and for determining the approximate amount of the consideration of the contract. Unless the contract is terminated by the failure of Congress to appropriate additional funds (see paragraph 1-08), the contractor will be required to complete the work specified in paragraph 1-02 hereof, be the required quantities more or less than the amounts shown.

| Item No. | Designation | Unit | Quantity |
|---|---|---|---|
| 1 | Earth Fill; Cofferdams | Cu. Yd. | 32,210 |
| 2 | Rock Fill; Cofferdams | " " | 164,000 |
| 3 | Unwatering Foundations | Sum | Job |
| 4 | Excavation; Common | Cu.Yd. | 847,000 |
| 5 | Excavation; Rock | " " | 11,900 |
| 6 | Excavation; Borrow | " " | 666,000 |
| 7 | Line Drilling | Sq.Ft. | 11,600 |
| 8 | Drilling 3" Exploratory Holes | Lin.Ft. | 3,000 |
| 9 | Drilling 6" Concrete Cores | " " | 500 |
| 10 | Drilling 6" Foundation Drains | " " | 800 |
| 11 | Drilling Foundation Grout Holes in Rock | " " | 10,000 |
| 12 | Drilling Foundation Grout Holes in Concrete | " " | 1,000 |
| 13 | Core Boxes | Each | 200 |
| 14 | Providing Pressure Grouting Equipment | Sum | Job |
| 15 | Pressure Grouting | Cu.Ft. | 10,000 |
| 16 | Rock Flour in Grout | " " | 2,000 |
| 17 | Sand in Grout | " " | 2,000 |
| 18 | Earth Fill; Compacted, Class I & Class II. | Cu.Yd. | 1,086,000 |
| 19 | Additional Compaction | Square (100sf) | 250,000 |
| 20 | Fill, Class III | Cu.Yd. | 381,000 |
| 21 | Filter | " " | 51,000 |
| 22 | Riprap; Dumped, Class A | " " | 20,000 |
| 23 | Riprap; Dumped, Class B | " " | 77,600 |
| 24 | Sand and Gravel Backing | " " | 17,000 |
| 25 | Rolled Gravel Surface | Sq.Yd. | 4,700 |
| 26 | Seeding | Acres | 10 |
| 27 | Concrete; Class A | Cu. Yd. | 1,300 |
| 28 | Concrete; Class B | " " | 91,200 |
| 29 | Special Bituminous Filler; Type C | Cu.Ft. | 230 |
| 30 | Steel Erection; Concrete Reinforcing | Lb. | 3,000,000 |
| 31 | Steel Erection; Structural | " | 466,000 |
| 32 | Steel; Structural, Miscellaneous | " | 1,000 |
| 33 | Steel Forgings; Miscellaneous | " | 200 |
| 34 | Control Gates; Erection | " | 456,000 |
| 35 | Hoists and Gantry Crane; Erection | Sum | Job |
| 36 | Iron; Cast | Lb. | 6,500 |
| 37 | Pipe; Cast Iron | " | 10,000 |
| 38 | Pipe; Wrought Iron | " | 2,600 |
| 39 | Pipe; Black Steel | " | 7,500 |
| 40 | Pipe; Concrete, Halved | Lin.Ft. | 1,000 |
| 41 | Drains; Porous Concrete | " " | 3,960 |

| Item: No. | Designation | Unit | Quantity |
|---|---|---|---|
| 42 | Corrugated Iron Water Stops | Lb. | 11,600 |
| 43 | Cable Guard Rail | Lin. Ft. | 3,800 |
| 44 | Bridge Guard Rail | " " | 1,270 |
| 45 | Handrailing; Steel Pipe 2" | " " | 1,300 |
| 46 | Handrailing; Steel Pipe 1-1/2" | " " | 300 |
| 47 | Safety Treads | Lb. | 500 |
| 48 | Floor Grating; Steel | " | 12,400 |
| 49 | Conduit; Metal | " | 1,000 |
| 50 | Doors; Steel | " | 1,450 |
| 51 | Air Bubbler System | Sum | Job |
| 52 | Stoplogs; Timber | " | " |
| 53 | Hatch Covers; Timber | " | " |
| 54 | Miscellaneous Equipment; Placing | Lb. | 470,000 |
| 55 | Electric Grounding System | Sum | Job |

### 1-06. COMMENCEMENT, PROSECUTION AND COMPLETION.

(a) The contractor will be required to commence work under the contract within ten (10) calendar days after the date of receipt by him of notice to proceed, to prosecute the said work with faithfulness and energy, and to complete the entire work within ______ calendar days after said date of receipt by him of notice to proceed, plus any extensions of time duly granted under the provisions of the contract and specifications. The work shall be prosecuted as vigorously as practicable during all seasons of the year.

(b) (1) The schedule of work under this contract will correlate with the schedule of work under other construction contracts, particularly those for Long Sault Dam and the Powerhouse. It is necessary that the completion of Stage 2 (see paragraph 1-12) of the Intake Works coincide with the completion of Stage 1 of Long Sault Dam. It is estimated that this will be approximately 18 months after the beginning of work on Long Sault Dam. The dates for completion of Stages 3 and 4 of the Intake Works may vary but Stage 5 of the Intake Works may not be commenced before the completion of Stage 2 of Long Sault Dam. It is estimated that this will be about 3-1/2 years after the beginning of work on Long Sault Dam. Thereafter, Stage 5 of the Intake Works, the closure of gate openings one by one, shall proceed during and in accordance eith the raising of the Long Sault pool. It is estimated that this closure operation will extend over a period of about 3 months.

From the completion of Stage 2 until the end of his work, the contractor shall operate the Intake Works in accordance with directions of the contracting officer. This operation will consist of stoplog manipulation, performed by means of the traveling gantry in combination with automatic operation of the control gates as they are installed.

(2) In case of failure on the part of the contractor to complete the entire work within the time agreed upon for its completion in (a) above, the contractor shall pay to the Government as liquidated damages the sum of $____________ for each calendar day of delay until construction is completed and the Intake Works is placed in operating condition as determined by the contracting officer.

(3) Should the construction be completed and placed in operating condition except for minor finishing work as determined by the contracting officer, the contracting officer may conditionally accept and occupy the

work; and thereafter the contractor shall pay to the Government, as liquidated damages the sum of $25.00 for each calendar day of delay until all the items and minor finishing work have been completed and accepted.

(4) In the event the entire structure has been completed and accepted and all work under the contract has been completed except for removal of contractor's plant and buildings and restoration of the site, no further liquidated damages will be assessed, but final payment will not be made until this latter work has been accomplished as required.

(c) If the completion of the undertaking to be performed under the terms of this contract be delayed by reason of delay in the delivery of materials or supplies essential to such performance because of national defense priorities and without the fault or negligence of the contractor, the time of performance will be extended for a period equal to such delay, as determined by the contracting officer, and subject to appeal, as provided in Article 9 of the contract.

1-07. SUNDAYS, HOLIDAYS, AND NIGHTS. - Work on Sundays, holidays, and nights will be at the option of the contractor. However, when the contractor elects to work at such times notice of his intention to do so shall be given the contracting officer within a reasonable time in advance thereof.

1-08. PAYMENTS.

(a) (Availability of Funds?)

(b) Payments will be made monthly on estimates of work performed in accordance with the contract and not included in any prior estimate, except that ten percent (10%) of the amount of each estimate will be retained until the total amount retained is __________ dollars(__________), and this amount will be retained until it equals ten percent (10%) of the remaining work to be done. Thereafter with each monthly payment there will be paid such portion of the amount so retained as is in excess of the percent (10%) of the work remaining to be done until the amount retained is reduced to __________ dollars (__________), which amount will be retained until the completion of the contract when final payment will be made.

1-09. WORK COVERED BY CONTRACT PRICE.

(a) The contractor shall, under his contract prices, furnish and pay for all materials (except as specified in paragraph 1-10), labor and equipment for all permanent, temporary, preparatory and incidental work, furnish all accessories and do everything which may be necessary to carry out the contract in good faith, which contemplates everything completed in good working order, of good material and with accurate workmanship, skillfully fitted and properly connected and put together.

1-10. MATERIALS FURNISHED BY THE UNITED STATES.

(a) The following material furnished by the United States will be delivered to the contractor f.o.b. at the site of the work:

(1) Cement and Concrete Aggregates.
(2) Reinforcement.
(3) Control Gates, Hoists, Gantry Crane and Appurtenances.
(4) Structural Steel.

The Government will at all times expedite the delivery of all orders but the Government will not be liable for any expense or delay caused the contractor by delayed deliveries except as provided for under Article 9 of the contract. The contractor shall be responsible that all railroad cars are unloaded promptly and will be held liable for any demurrage charges due to his failure to do so. He will be required to unload, deliver to site, store, clean, assemble, install, and paint this equipment and materials in accordance with these specifications, and the contract drawings.

(b) All materials and equipment shall be adequately housed or otherwise protected against deterioration and damage. When material stored at the site is not adequately protected by the contractor, such material will be kept protected by the contracting officer at the expense of the contractor. Any materials furnished by the Government, which are damaged or broken by the contractor during the unloading, storing, or transporting of such materials, or in the prosecution of the work, shall be replaced by the contractor at his expense.

(c) The contractor shall check the quantity and condition of all materials delivered to him at the time of unloading, and in case there is damage to, or shortage of materials, he shall report it to the contracting officer in writing within 24 hours after delivery. If there is any shortage, or damage which in the opinion of the contracting officer is sufficient to cause the materials to be unfit for use in the work, and the shortage or damage has not been reported as specified above, the contractor will be charged with the actual cost of replacement of such shortage or damage.

(d) Cement and Aggregates for Concrete. - The Government will furnish all cement, fine aggregate, and coarse aggregate required for the work covered by these specifications. All cement furnished for concrete except high early strength cement, will be a moderate-heat-of-hardening Portland cement. All aggregates furnished (see Section V) will be either natural or manufactured sand, and gravel or crushed rock. Explorations and investigations are being conducted by the contracting officer for concrete aggregates. The results of these investigations will be made available to interested bidders at the U. S. Engineer Office, Massena, N. Y., and bidders may also, by request, obtain a copy of the Government specifications for the concrete aggregates to be furnished.

(e) Cement and aggregates will be made available to the contractor at any time later than 90 days after the date of notice to proceed, and he shall give the Government at least 90 days notice in advance of the time he will require the first material. Thereafter he shall at all times keep the contracting officer informed of his anticipated requirements by submitting, ten days before the first of each month or at such other times as may be directed by the contracting officer, a written notice of his future cement and aggregate requirements for the next 30 days. Copies of all orders for cement will be furnished promptly to the contractor. The cement will be furnished in bulk except that necessary for grouting and finishing work, which will be furnished in paper bags. Any cement, bulk or bag, which shall be damaged after delivery to the contractor shall be paid for by him. Any difference in excess of one-half of one percent between the net quantity of bulk cement and aggregates delivered to the contractor, and the quantity of the above materials incorporated in the completed and accepted work will be charged to the contractor, at its cost to the Government at the point of delivery to the contractor. The quantity of bulk cement and aggregates delivered to the contractor will be determined by certified shipping weights. The contractor shall provide, at the site, a minimum storage for 5,000 barrels of bulk cement and 100 barrels of bag cement, and shall be prepared to receive and stockpile a minimum of 20, 000 tons of concrete aggregates. In order that cement will not become unduly aged after delivery, the contractor shall not use cement in the work directly from the freighting or transporting operations whenever any cement is available that has been stored more than 60 days after delivery to the contractor. Cement that has been stored for more than 90 days shall be retested at the expense of the contractor. (See paragraph 1-31(d).) Storage bins for cement shall be so constructed that there will be no dead storage and will provide adequate protection against the elements.

(f) Cement and aggregates furnished by the Government may be used by the contractor in erecting construction plants and facilities. The contractor will be billed for the actual cost to the Government at the point of delivery for furnishing the materials so used by the contractor. The materials thus used shall not be included in the one-half of one percent tolerance specified above.

(g) The contractor shall be responsible for unloading and handling all cement and aggregates furnished by the Government. The cost of such unloading, storing or stockpiling shall be included in the contract unit prices for those items on which the material will be used.

(h) The contractor shall return to the Government, f.o.b. in cars at the point of delivery, all cement furnished by the Government and not used. The contractor will be charged for any cement, not used and not returned, except for one-half of one percent allowed for loss, an amount equal to the cost to the Government at the point of delivery to the contractor.

(i) Reinforcement. - Reinforcement will be cut to length and bent before delivery. See paragraph 5-14 for specified placing requirements.

(j) Reinforcement will be made available to the contractor within 150 days after the contractor notifies the Government he will require such reinforcement, and he shall furnish written notice of his requirements for the first four months. Therafter he shall at all times keep the contracting officer informed of his anticipated requirements for reinforcement in the following manner: On the first day of the first 4-month period the contractor shall furnish written notice of his future requirements during the second 4-month period, and so on through the duration of the contract. Upon receiving notice to proceed, the contractor shall also furnish the contracting officer a general schedule of reinforcement requirements for the duration of the contract by 4-month periods, it being understood that shipments may be based on definite requirements as stated in the contractor's regular periodic notices of requirements. Copies of all orders for concrete reinforcement will be furnished promptly to the contractor. Any reinforcement which shall be damaged after delivery to the contractor, and any difference in excess of one-half of one percent between the net quantity of reinforcement delivered to the contractor and the quantity incorporated in the completed and accepted work will be charged to the contractor, at its cost to the Government at the point of delivery to the contractor. The quantity of reinforcement delivered to the contractor will be determined by certified shipping weights.

(l) Control gates, structural steel, gantry crane, fixed hoists and appurtenances (see Section VII and VIII) will be made available for erection by the contractor. The contractor shall furnish written notice and schedule of his requirements for the control gates, structural steel, gantry crane, hoists, and appurtenances, at least 150 days before the time proposed for starting erection.

1-11. ELECTRICAL ENERGY DURING THE CONSTRUCTION PERIOD. - The United States will provide a source of electrical energy without cost to the contractor at a point on the east bank of the existing canal and within 500 feet of the abutment. The capacity of this source will be 2000 K.V.A. at 6,600 volts, 3-phase, 60 cycle. The contractor, if he elects to use this power, shall provide, without cost to the United States, all facilities and equipment necessary to furnish himself with electrical energy for power and lighting from the above source. This shall include a meter, metering equipment, transformers, poles, switches, lights, and any other equipment that may be necessary. The contractor will be required to light during the construction period all highways built by him, and all job roads, galleries within the structure, outside work areas, all safety lights (see Paragraph 1-22), and any other lighting as directed all to the satisfaction of the contracting officer. Energy will be 3-phase, 60-cycle, for the operation of all permanent government equipment, and shall be furnished at the voltages as required for each specific use or as indicated on the drawings. The contractor shall maintain service until completion of the contract. All costs for electrical energy shall be borne by the contractor. The contractor shall make payment to the United States each month for electrical energy furnished him, at the rate of the actual cost to the United States, plus 10% to cover installation and overhead, for supplying the electrical energy. The rate of the actual cost to the United States may be obtained at the U. S. Engineer Office, Massena, N. Y.

1-12. ORDER OF WORK. (a) The following general program of work is contemplated, subject to such modification as may be found necessary or desirable by the contracting officer. Should the contractor desire at the time of making his proposal to change this general program other than dates of beginning, completion of Stage 2, commencement of Stage 5, and completion of the canal, he shall so state in his proposal. The program must permit an uninterrupted flow of water down the canal at all times. The main features of the work are as follows:

(1) First Stage: Will include the excavation for and construction of the spillway, the south bulkhead, the first two monoliths of the north bulkhead, and the training walls.

(2) Second Stage: Will include the excavation of the new canal and the construction of cofferdams across the old canal.

(3) Third Stage: Will include the excavation for and completion of the remainder of the north bulkhead.

(4) Fourth Stage: Will include the construction of the north wing dam and completion of the south wing dam.

(5) Fifth Stage: Will include the construction of the concrete discharge conduits of the intake and installation of the control gates and hoists. Further description of the work to be performed during these stages is given in Section II.

(b) Concurrently with any of the foregoing operations the contractor may also carry on any other operations that do not, in the opinion of the contracting officer, impair safety, nor in any way adversely affect the work, nor divert force, equipment, or material that should be contributing to the progress of operations of higher priority.

(c) The contractor shall at all times keep the contracting officer informed of the order of proposed operations. To this end, in addition to the charts required to be submitted in accordance with paragraph 16(d) of the Invitation for Bids, the contractor shall furnish such supplementary charts and /or other information regarding proposed future operations as may be required by the contracting officer.

1-13. RIGHT-OF-WAY. - The right-of-way for the work covered by these specifications will be furnished by the Government.

## 1-14. ROADS AND GROUNDS.

(a) The contractor shall have the privilege of using the Government-controlled land within the work areas shown on sheet No. 2 of the drawings, except for that part of said lands as may be reserved by the contracting officer for other purposes.

(b) At any time during the progress of the work the contractor shall, when so directed by the contracting officer, promptly vacate and clean up, within 60 days after written notice, without expense to the Government, any part of the grounds which have been in use by him when such grounds are needed for other purposes. The contractor shall keep the buildings and grounds in use by him at the site of the work in an orderly and sanitary condition and shall provide suitable extinguishers or other fire-fighting apparatus for ready use in all buildings erected or in use by the contractor on Government property.

(c) The contractor shall not obstruct any existing roads on the lands controlled by the United States and shall maintain all roads in the vicinity of the work in as good condition as exists at the time of commencement of the work. Before construction of the south wing dam blocks the existing road, the contractor shall construct a temporary road to connect the existing road east of the south wing dam with State Highway Route 37B. The contractor shall maintain the temporary road in serviceable condition until completion of the contract. No separate payment will be made for construction or maintenance of temporary roads, or for maintenance of existing roads.

(d) The contractor will be required to construct a covered wooden observation platform having an area of about six-hundred (600) square feet for the use of the general public. This platform shall be constructed at a location selected by the contracting officer. The contractor shall also provide suitable and safe access to the observation platform for the general public so that it may observe the work in progress. No separate payment will be made for this work.

## 1-15. CAMP CONSTRUCTION AND SUPERVISION.

(a) The construction, operation and maintenance of facilities for the quartering and subsisting of the contractor's employees will be subject to the approval of the contracting officer if the facilities are located on Government property. The contractor will be permitted to construct such facilities on the right-of-way owned by the Government only at such locations specifically approved by the contracting officer. The type of construction and design for the buildings erected by the contractor will be subject to the approval of the contracting officer. Expensive or permanent types of construction will not be required, but no unsightly, unsanitary shacks or shanties will be permitted. The contractor will be required to comply with State and local laws relative to police and sanitary measures and with other protective measures imposed by the contracting officer in the administration of his camps. In the event of noncompliance with such laws and regulations, the contracting officer will enforce them at the expense of the contractor. The contracting officer may require the contractor to discharge any employee from the work for violation of camp regulations. (See paragraph 1-21)

(b) In the event the contractor makes arrangements with landowners, other than the Government, near the site of the work for the construction of temporary facilities for the quartering and subsisting of his employees, he will be subject, in the operation and maintenance of such a camp, to all the provisions of subparagraph (a) above with respect to the requirements for compliance with all State and local laws relative to police and sanitary measures, and with measures such as safety, fire hazard and protection, etc., imposed by the contracting officer. In the event of noncompliance with such laws and regulations while operating and maintaining a temporary camp not on the Government-owned or controlled property, the contracting officer will enforce them at the expense of the contractor. The contracting officer may require the contractor to discharge from the work any employee for violation of camp regulations, notwithstanding the fact that the camp may not be located on Government-owned or controlled property.

(c) In the event the contractor provides subsistence for his employees, he shall also provide subsistence to such Government employees as may require such accommodations and at the same rates charged his own employees.

(d) No business or recreational facilities shall be established or operated on Government-owned or controlled lands without the written approval of the contracting officer.

### 1-16. BORROW PITS.

(a) Should the contractor locate deposits of bank run sand and gravel or other materials within the Government-controlled area in the reservoir or adjacent to the site, which are satisfactory to the contracting officer, he may, on approval of the contracting officer, use such deposits. No charge will be made to the contractor for materials authorized to be taken from Government-controlled lands and used in the work covered by these specifications. All borrow pits shall be left in a neat and sightly condition, and all pits above the normal ground water table shall be adequately drained. Side slopes shall be not steeper than 1 on 3. No separate payment will be made for such work.

(b) Approval of material sources by the contracting officer shall not constitute approval of all materials taken from such deposits and the contractor will be responsible for the quality of all materials used in the work.

(c) Should the contractor obtain materials from deposits on private lands he shall pay any royalties or other charges required, and the contracting officer assumes no responsibility for such use, and the Government will not be obligated in any way.

1-17. DATUM AND REFERENCE BENCH MARKS. - The plane of reference used in these specifications and on the drawings is Mean Sea Level. Elevations referring to this datum plane are to be determined from the following bench mark: See Bulletin 514, Results of Spirit Leveling in New York. U. S. Geological Survey, page 59.

> "House of Norman Hopson, corner of fence in
> turn of road at, on north side of river road,
> 2.8 feet from fence corner; top of roundheaded
> brass bolt set in concrete base (U. S. Corps
> of Engineers 5), Elevation 247.357."

This bench mark is approximately one and one-half miles east of the site of the work.

### 1-18. PHYSICAL DATA.

(a) Foundation data. - Investigations made at the site by the

United States to determine the character of the foundation materials are shown on the drawings referred to in paragraph 1-04.

The United States does not guarantee that other materials will not be encountered nor that the proportions of the serveral materials will not vary from those indicated by the explorations. Bidders are expected to examine the site of the work, the logs of boring, test pits, probings, and the cores and samples which are available at the U. S. Engineer Office, Massena, New York, and, after investigation, decide for themselves the character of the materials and make their bids accordingly.

(b) Weather Conditions. - Meteoroligical date in the form of rainfall, snow, and temperature records, prepared from records covering a period of 33 years (1907 to 1939, inclusive) of the U. S. Weather Bureau Station at Canton, New York, approximately 35 miles southwest of the site of the work, are as follows:

| | Temperature Degrees Fahrenheit | | | Precipitation (Mean Monthly) | |
|---|---|---|---|---|---|
| Month | Mean Monthly | Extreme Max. | Extreme Min. | Total Inches | Inches of Snow |
| January | 16.8 | 61 | -41 | 2.64 | 14.9 |
| February | 15.8 | 63 | -43 | 2.30 | 15.5 |
| March | 27.9 | 78 | -30 | 2.60 | 13.1 |
| April | 41.7 | 85 | -1 | 2.59 | 4.9 |
| May | 54.2 | 93 | 21 | 3.03 | 0.2 |
| June | 63.5 | 97 | 30 | 3.51 | 0 |
| July | 68.8 | 99 | 34 | 3.62 | 0 |
| August | 66.5 | 96 | 35 | 3.42 | 0 |
| September | 58.8 | 91 | 25 | 3.44 | 0.1 |
| October | 47.4 | 83 | 14 | 3.04 | 1.0 |
| November | 35.0 | 75 | -15 | 3.02 | 7.5 |
| December | 21.4 | 61 | -37 | 2.62 | 14.5 |

(c) St. Lawrence River Water Temperature. - The St. Lawrence River water temperatures prepared from records covering a period of 8 years (1933 to 1940, inclusive) of the City Engineer, Ogdensburg, New York, are as follows:

Water Temperature - Degrees Fahrenheit

| Month | Mean Monthly | Extreme Maximum | Extreme Minimum |
|---|---|---|---|
| January | 32.7 | 36 | 32 |
| February | 32.9 | 37 | 32 |
| March | 33.0 | 37 | 32 |
| April | 36.2 | 46 | 32 |
| May | 46.9 | 60 | 37 |
| June | 58.8 | 66 | 49 |
| July | 65.5 | 73 | 59 |
| August | 70.5 | 74 | 63 |
| September | 64.6 | 72 | 59 |
| October | 56.4 | 65 | 50 |
| November | 46.5 | 52 | 37 |
| December | 35.7 | 44 | 32 |

The above data are included for the information of the contractor. The Government assumes no responsibility for their completeness or accuracy or for deductions, interpretations, or conclusions drawn therefrom.

(d) River Stages. - The U. S. Lake Survey Standard Low Water Datum of the St. Lawrence River at the site of the work is at Elevation 200.4, the maximum range of stage under present conditions being from about Elevation 197 to about Elevation 206. The location has not been, in so far as can be determined, subject to higher stages due to backwater from ice gorges downstream.

The construction of the Long Sault Dam will materially affect the river stages at the Massena Intake (see paragraph 1-06 (b)). During the first construction stage of the Long Sault Dam, the conditions of the river at the intake will not be materially affected. During the second Long Sault Dam stage, extending over a period of about 2 years, the present diversion Weir of the Massena Intake will be removed, but it is anticipated that stages at the Intake Works will remain approximately as under present conditions. During the closure period of the Long Sault Dam, the pool will be raised gradually to Elevation 210 and quickly thereafter to Elevation 235.

(e) Utilities. - In the event that power lines, telephone or telegraph lines, pipe lines, cables, or other utilities are encountered within the limits of the work including the right-of-way for the temporary road, the contractor shall notify the contracting officer in writing of any necessary changes in such utilities not less than 30 days in advance of the date he desires such changes made. The contracting officer will arrange for the relocation or reconstruction of such utilities by other agencies, or will authorize the contractor to remove them, at no extra cost to the Government, to the extent required for execution of the contract work.

1-19. TRANSPORTATION FACILITIES. - The following data on transportation facilities is furnished for the information of the contractor but the Government assumes no responsibility for its completeness or accuracy and the contractor is expected to investigate the conditions and determine for himself the probable transportation facilities available.

(a) Railroads. - Massena, N. Y., is served by the New York Central Railroad and a branch line of the Canadian National Railway (known as the Grand Trunk Lines in the United States ). Plans are now being developed for a construction railroad to be built by others, such railroad to connect with existing lines. The contemplated railroad will cross the Grass River or the Massena Power Canal, and will probably terminate a few miles northeast of Massena, N. Y.

(b) Highways. - The town of Massena, N. Y., is served by New York State Highways No. 37 and No. 56, the latter connecting with U. S. Highway No. 11 at Potsdam, N. Y., about 25 miles distant. State Highway No. 37 B passes within one-half mile of the site and improved town roads connect the site of the work with that highway and with the village of Massena.

(c) Water. - The nearest ports to the site of the work providing docking and other harbor facilities are Cornwall, Ontario, Canada, and Waddington, N. Y., each being about 15 miles from the site. They are accessible by water from Lake Ontario and from the head of deep-water navigation at Montreal by means of the St. Lawrence Canals and open-river stretches of navigable channels. Locks in the canals generally limit the size of craft to widths less than 45 feet, lengths less than 250 feet, and drafts less than 14 feet. The river is navigable to points closer to the site but no docking facilities exist at the present time. Shallow draft vessels can navigate to the site. For a detailed description of the existing canal and lock clearances and depths, the contractor is referred to the booklet "The Canals of Canada," published by the Department of Transport, Ottawa, Ontario, Canada, copies of which are available for inspection in the U. S. Engineer Office, Massena, N. Y. The navigation season is usually limited by ice conditions to the period from April 20 to December 1.

### 1-20. ORGANIZATION, PLANT AND PROGRESS.

(a) The contractor shall perform, directly and without subcontracting, not less than fifty percent (50%) of the work, to be calculated on the basis of the contract price.

(b) The contractor shall employ an ample force of properly experienced men and provide a construction plant properly adapted to the work and of sufficient capacity and efficiency to accomplish the work in a safe and workmanlike manner at the rate of progress specified in his bid. All plant shall be maintained in good working order and provision shall be made for immediate emergency repairs. No reduction in the capacity of the plant employed on the work shall be made except by written permission of the contracting officer. The measure of the "capacity of the plant" shall be its actual performance on the work to which these specifications apply. It is understood that award of this contract shall not be construed as a guaranty by the United States that plant listed in statement of contractor for use on this contract is adequate for the performance of the work.

(c) Should the contractor fail to maintain the rate of progress proposed in his bid, the contracting officer may require that additional men or plant, or both, be placed on the work, working if necessary during additional periods, or a reorganization of plant layout be effected in order that work be brought up to schedule and maintained there. Should the contractor refuse or neglect so to increase the number of men or plant, or both, or to reorganize the plant layout in the manner satisfactory to the contracting officer, the latter may proceed under the provisions of Article 9 of the contract.

### 1-21. LIABILITY AND SAFETY REQUIREMENTS.

(a) Accident Prevention. - In order to protect the life and health of employees in the performance of this contract, the contractor will comply with all pertinent provisions of the "Safety Requirements in Excavation - Building - Construction" approved by the Chief of Engineers, December 16, 1941, (a copy of which is on file in the office of the contracting officer) and as may be amended, and will take or cause to be taken such additional measures as the contracting officer may determine to be reasonably necessary for this purpose. The contractor will maintain an accurate record of and will report to the contracting officer in the manner and on the forms prescribed by the contracting officer, all cases of death, occupational disease and traumatic injury arising out of or in the course of employment on work under this contract. The contracting officer will notify the contractor of any non-compliance with the foregoing provisions and the action to be taken. The contractor shall, after receipt of such notice, immediately correct the conditions to which attention has been directed. Such notice, when served on the contractor or his representative at the site of the work, shall be deemed sufficient for the purpose aforesaid. If the contractor fails or refuses to comply promptly, the contracting officer may issue an order stopping all or any part of the work. When satisfactory corrective action is taken, a start order will be issued. No part of the time lost due to any such stop order shall be made the subject of claim for extension of time or for excess costs or damages by the contractor.

(b) The contractor will not be allowed to block or obstruct any public highway without having secured prior permission from the contracting officer, and he shall provide safe, temporary detours. During the time the public highways may be so blocked, the contractor shall place danger lights, barricades and warning signs in accordance with the laws of the State of New York.

(c) The contractor shall be responsible that his employees strictly observe the laws of the United States affecting all operations at the site under the contract. He shall comply with all applicable Federal, State and local laws, including those concerning the inspection of boilers and other equipment, the licensing of engineers and other employees.

(d) The United States will not be responsible for any damage to or increased difficulties in performance of the work under this contract on account of any scour or other changes in the river bed or banks or water currents resulting from other construction at the site, and no payments, allowances or deductions will be made for or on account of any such damage or difficulties.

(e) Nothing in this paragraph shall be construed as modifying the responsibility of the contractor as set forth in Article 10 of the contract.

1-22. LIGHTS. - The contractor shall, at his own expense, display proper lights continuously each night, between the hours of sunset and sunrise and during fogs, upon all floating plant connected with the work, and all ranges and other stakes in connection with it, when necessary in the opinion of the contracting officer, and shall be responsible for all damages resulting from any neglect or failure in this respect. If work is done at night the contractor shall maintain, from sunset to sunrise, such lights on or about his plant as the contracting officer may deem necessary for the proper observation of the operations.

1-23. USE OF EXPLOSIVES. - The contractor shall use the utmost care in the use of explosives necessary for the prosecution of the work, not to endanger life or property. All blasting operations shall be conducted by experienced men only. The handling and use of explosives shall be done strictly in accordance with the latest methods and rulings to insure safety, in accordance with the specifications issued by the U. S. Bureau of Mines, and in compliance with the local and State laws. Failure to observe necessary precautions will be sufficient grounds for temporary suspension of the work. All explosives shall be transported and stored in a secure manner, and in accordance with local and State laws; all vehicles and such storage places shall be marked clearly "DANGER - EXPLOSIVES," and shall be in the care of competent watchmen at all times. In no case shall caps or other detonators be stored or transported with dynamite or other explosives. The location of magazines for the storage of explosives and for the separate storage of detonators shall be subject to the approval of the contracting officer.

1-24. PROPERTY DAMAGE.

(a) Damage to Government property or to the works due to failure of the contractor to carry out the terms of the contract and specifications, to take reasonable precaution, or to maintain progress to approved schedules, or to carry out the instructions of the contracting officer shall be made good by the contractor without expense to the United States. He will also be held responsible for any damage done to adjoining property through his neglect or failure to take proper precautions (see Article 10 of the Contract.)

(b) The contractor will not be held responsible for damage sustained by the permanent work from accident, flood, or exposure where such damage is not due to his fault or negligence and where the work is being conducted in accordance with the terms and schedule of the contract and specifications, but he shall make such repairs as the contracting officer may direct to such damaged portions of the work, at the applicable contract unit prices for the various items of work.

## 1-25. INSPECTION.

(a) The work will be conducted under the general direction of the contracting officer and will be inspected in accordance with Article 6 of the contract by inspectors appointed by him. The inspectors will keep a record of the work done and see that the location and limit marks are kept in proper order, but the presence of the inspector shall not relieve the contractor or his responsible agent (see Article 8 of the contract) of responsibility for the proper execution of the work.

(b) Should the contractor refuse, neglect or delay compliance with the requirements concerning facilities for inspection and layout (see paragraph 1-26), the specific facilities may be furnished and maintained by the contracting officer, and the cost thereof deducted from any amounts due or to become due the contractor.

(c) Except as specified in this paragraph, in Article 6 of the contract, and in paragraphs 1-31 (d) and 1-26, all expenses of inspection will be borne by the United States.

(d) The contractor shall furnish a suitable room containing at least 150 square feet of floor space, at his concrete mixing plant for a Government laboratory to be used for temporary storage of concrete cylinders, and determination of moisture content of the concrete aggregate. This room shall be protected from the weather, properly lighted, provided with necessary work tables and benches, and shall be heated if concrete work is done in cold weather. The location for this room shall be subject to the approval of the contracting officer.

(e) Portable Building. - The contractor shall furnish a suitable portable building, located as required by the contracting officer within the site of the work, for use by the Government. This building shall be approximately 10 feet by 12 feet and shall be supplied with an instrument rack, a built-in desk, clothes lockers, supply cabinet with lock, bench and such other appurtenances as may be required by the contracting officer. The building may be of any type construction as approved by the contracting officer and shall be movable, as the contracting officer may require its location to be shifted during progress of the work. It shall be reasonably weather proof, and shall be supplied with heat and electric lights without cost to the Government.

(f) It is understood that any instructions, or decisions given by a superior officer, through the contracting officer, are to be considered instructions or decisions of the contracting officer, in all cases where, under the terms of this contract, decision rests with the contracting officer.

## 1-26. LINES, GRADES AND MEASUREMENTS.

(a) The work shall be carried out in strict accordance with lines, grades, and dimensions shown on the drawings or as directed from time to time by the contracting officer.

(b) The contractor shall, at his own expense, furnish all stakes, templates, patterns, platforms and special labor that may be required in setting and cutting, or laying out any part of the work.

(c) The contracting officer will furnish the control points, lines, grades, and elevations necessary to enable the contractor to commence construction work. After this original layout has been made by the contracting officer, it shall be the responsibility of the contractor to supply and maintain all additional survey points, grade stakes, form locations and other work lines necessary for the proper execution and conduct of the work. From time to time during the progress of the work, the contracting officer will check the contractor's lines and grades to determine whether or not the work is being accurately and properly executed, but such checks will in no way relieve the contractor of the responsibility for executing the work in accordance with the plans and specifications, and the original field layout furnished by the contracting officer.

(d) Bench marks, triangulation stations, and principal control points shall be preserved by the contractor and in case of their destruction or removal by him or his employees, they will be replaced by the contracting officer at the contractor's expense.

1-27. CHANGES AND CHANGED CONDITIONS. - When changes are made in the specifications or drawings, or changed conditions are encountered during the progress of the work, which cause an increase or decrease in the amount due under the contract, or in the time required for its performance, an equitable adjustment shall be made in accordance with Articles 3 and 4 of the contract.

1-28. MINOR MODIFICATIONS.- The right is reserved to make such minor changes in the execution of the work to be done under these specifications as, in the judgment of the contracting officer, may be necessary or expedient to carry out the intent of the contract; provided, that the unit cost to the contractor of doing the work shall not be increased thereby, and no increase in unit price over the contract rate will be paid to the contractor on account of such changes. (See Articles 3, 4, and 5 of the contract.)

1-29. CLAIMS, PROTESTS AND APPEALS.

(a) If the contractor considers any work demanded of him to be outside the requirements of the contract or if he considers any action or ruling of the contracting officer or of the inspectors to be unfair, the contractor shall without undue delay, upon such demand, action, or ruling, submit his protest thereto in writing to the contracting officer, stating clearly and in detail the basis of his objections. The contracting officer shall thereupon promptly investigate the complaint and furnish the contractor his decision, in writing, thereon. If the contractor is not satisfied with the decision of the contracting officer, he may, within thirty days, appeal in writing to the Secretary of War whose decision or that of his duly authorized representative shall be final and binding upon the parties to the contract. Except for such protests or objections as are made of record in the manner herein specified and within the time limit stated, the records, rulings, instructions or decisions of the contracting officer shall be final and conclusive.

(b) All appeals from decisions of the contracting officer authorized under the contract shall, be addressed to the Secretary of War, Washington, D. C. The appeal shall contain all the facts or circumstances upon which the contractor bases his claim for relief and should be presented to the contracting officer for transmittal within the time provided therefor in the contract.

1-30. PATENTS. - The contractor shall hold and save the Government, its officers, agents, servants and employees, harmless from liability of any nature or kind, including costs and expenses for or on account of any patented or unpatented invention, article or appliance manufactured or used in the performance of this contract, including its use by the Government.

## 1-31. STANDARD TESTS, QUALITY AND GUARANTEES.

(a) All materials furnished by the contractor, supplies and parts, and assemblies thereof, entering into the work to be done under these specifications, shall be tested as specified herein, or if not specified, in conformity with Article 6 of the contract and according to the best modern approved methods for the particular type and class of work.

(b) Unless otherwise authorized or directed, where standard published specifications of recognized authorities or organizations are specified, the latest revision of such specifications current at the time the Work is executed shall govern.

(c) Unless waived in writing by the contracting officer, all tests and trials shall be made in the presence of a duly authorized representative of the contracting officer. When the presence of the inspector is so waived, sworn statements, in triplicate, of the tests made and the results thereof, shall be furnished the contracting officer by the contractor as soon as possible after the tests are made.

(d) All costs of all tests and trials, excepting the expenses of the Government inspector, shall be borne by the contractor and shall be included in the contract price, unless specified otherwise.

(e) In accordance with Article 7 of the contracr, all materials, supplies and articles furnished and incorporated in the permanent structure shall be of the highest grade, free from defects and imperfections, of recent manufacture, and unused. Workmanship shall be of the highest grade and in accordance with the best modern standard practice.

(f) All articles, supplies, equipment, parts and assemblies thereof, of standard manufacture, or for which detail design or requirements are not prescribed in these specifications shall be guaranteed by the contractor against any failure in proper use or operation, caused by defective material, workmanship or design, for a period of one year from the date of final acceptance of the complete work under this contract. Failure in any part due to such causes within that time shall be promptly and satisfactorily remedied by the contractor without cost to the United States.

1-32. PROTECTION OF STORED MATERIALS. - All materials, supplies and articles delivered at the site shall be adequately housed or otherwise protected against deterioration and damage to the satisfaction of the contracting officer. When material stored at the site and partly paid for is not adequately protected by the contractor, such material will be kept protected by the contracting officer at the expense of the contractor, and no partial payments will be made upon future delivery of the articles or commodities in question.

1-33. MISPLACED MATERIAL. - Any material that is deposited elsewhere than place designated or approved by the contracting officer will not be paid for, and the contractor may be required to remove such material and waste it or redeposit it as directed.

## 1-34. STANDARD STOCK PRODUCTS.

(a) All materials, supplies and articles furnished shall, wherever so specified, and otherwise wherever practicable, be the standard stock products of manufacturers other than those specified will be accepted when it is proved to the satisfaction of the contracting officer that they are equal in strength, durability, usefulness and convenience for the purpose intended (see Article 7 of the contract). Any changes required in the details and dimensions shown on the drawings for the substitution of standard stock products, other than those provided for, shall be properly made as approved by the contracting officer, and at the expense of the contractor. The references herin to brands and catalog numbers are intended to be descriptive and not restrictive, and are used only to indicate articles that will be satisfactory. Other makes and catalog numbers will be accepted provided that they are similar and equal to those specified herein or called for on the drawings.

(b) Data to be Submitted for Approval. In accordance with Article 7 of the contract, prior to the placing of any purchase order for products of standard manufacture, and sufficiently in advance of the proposed purchase date to enable the contracting office to determine whether the proposed product conforms to the specifications, the contractor shall submit for the approval of the contracting officer complete descriptive data in triplicate, consisting of dimensioned drawings, catalog references and specifications, typical performance records, and such other information as may be required to be submitted on special forms to be furnished by the contracting officer to identify clearly each product in question. The term " or equal" shall not be used in any descriptive information furnished. Except at the contractor's risk, no purchase order shall be placed for any product which has not been approved by the contracting officer.

(c) Final Completion Data. - There shall be supplied 5 complete sets of data, each separately bound in a leather binder, for each major item of equipment furnished and installed under this contract. These data shall consist of all necessary instruction bulletins, complete drawings, complete parts and material lists positively identifying each part, manufacturer's recommendation as to spare parts, and all other necessary data.

## 1-35. PREFERENCE FOR DOMESTIC ARTICLES.

(a) With reference to article 18 of the contract, because the materials listed below, or the materials from which they are manufactured, are not mined, produced, or manufactured, as the case may be, in the United States in sufficient and reasonably available commercial quantities and of a satisfactory quality, their use in the work herein specified is authorized without regard to the country of origin:

Platinum
Chromium
Cork
Jute
Kaurigum
Lac
Asphalt

Nickel
Rubber
Teak Wood
Silk
Sisal
Tin
Aluminum

Asbestos
China Wood Oil (Tung Oil)
Balsa Wood
English Ball Clay
English China Clay
Natural Copper-Nickel Alloy
Diamonds

(b) Articles, materials or supplies manufactured in the United States and containing mercury, antimony, tungsten or mica of foreign origin may be used in the work herein specified because such manufactured articles, materials, or supplies have been manufactured in the United States substantially all from articles, materials, or supplies, mined, produced or manufactured, as the case may be, in the United States.

1-36. INTERFERENCE WITH OTHER CONTRACTORS. - Other contractors will perform work on the Massena Canal Intake Works pertaining to installing and placing electrical and operating equipment. In addition other major work will be undertaken in the vicinity of the Intake Works at approximately the same time, such as the Long Sault Dam, the Long Sault Canal, locks, powerhouses, and highway relocations. The contractor shall not interfere with material, appliances or workmen of the United States or of any other contractor who may have work at this site. As far as practicable, all contractors shall have equal rights to the use of all roads, grounds, and adjacent river, and make equitable agreements among themselves for the use of temporary railroads and highways. In case of disagreement regarding such use, the decision of the contracting officer shall govern. (See Article 13 of the contract.)

1-37. RESTORATION OF SITE. - Before final payment is made, the contractor shall remove from the site, without expense to the United States, all rubbish, and unused materials provided by him, temporary buildings, and other structures erected by him, shall fill all holes or cavities made for his convenience, except as otherwise provided, and shall leave the whole site in good order and condition, all as required by the contracting officer.

1-38. WAGE AND LABOR PROVISIONS.

(a) Pursuant to the provisions of Article 17 of revised United States Standard Form No. 23 the following wage rates have been determined by the Department of Labor:

SCHEDULE OF WAGE RATES

| Classification | Minimum Rate per Hour |
|---|---|
| Blacksmith | |
| Blacksmith Helper | |
| Boilermaker | |
| Boilermaker Helper | |
| Bricklayer | |
| Bricklayer Tender | |
| Carpenter (Skilled) | |
| Carpenter, Apprentice, 1st year | |
| Carpenter, Apprentice, 2d year | |
| Carpenter, Apprentice, 3d year | |
| Concrete Finisher (Rough concrete) | |
| Concrete Form Stripper | |
| Concreteman (Puddler, Screeder, Vibratorman & Curing) | |
| Conveyor Tender | |
| Deckhand (Dredge) | |
| Dumpman (Spotter & Grademan) | |
| Electrician | |
| Electrician Helper | |
| Engineman (Stationary Power Plants) | |
| Fireman | |
| Glazier | |
| Hooktender (Concrete Placement) | |
| Laborer (Common) | |
| Laborer (Dredge) | |
| Machinist | |
| Machinist Helper | |

SCHEDULE OF WAGE RATES (Con'td)

| Classification | Minimum Rate per Hour |
|---|---|
| Mason (Stone) | |
| Mechanic | |
| Mechanic Helper | |
| Millwright | |
| Motorman (Dinky) | |
| Oiler | |
| Operators of Power Equipment: | |
| Air Compressor (over 750 c.f.m.) | |
| Air Compressor (750 c.f.m. and under) | |
| Air Hammer (Jackhammer, Pavement Breaker, etc) | |
| Cement Pump | |
| Concrete Batching Plant | |
| Concrete Mixer | |
| Concrete Pump | |
| Core Drill | |
| Crane (except Gantry Crane) | |
| Derrick | |
| Dragline | |
| Elevating Grader | |
| Gantry Crane | |
| Grader (Finish) | |
| Grader (Rough) | |
| Grout Machine | |
| Hoist | |
| Launch Operator (150 H.P. or under) | |
| Pile Driver | |
| Power Saw | |
| Power Scraper | |
| Pump (100 H.P. or over) | |
| Pump (under 100 H.P.) | |
| Screening Plant | |
| Shovel | |
| Tractor (under 35 H.P. without attachments) | |
| Tractor (35 H.P. and over, and all tractors with attachments) | |
| Painter | |
| Pile Drivermen, Leadsmen, Linesmen, Nozzlemen, Winchmen | |
| Pipe Fitter | |
| Pipe Fitter Helper | |
| Plasterer | |
| Plasterer Tender | |
| Plumber | |
| Plumber Helper | |
| Powderman | |
| Powderman Helper | |
| Reinforcing Steel Worker | |
| Rigger | |
| Roofer | |
| Sheetmetal Worker | |
| Signalman, Concrete Placement (Phone man) | |
| Structural Steel Worker | |

## SCHEDULE OF WAGE RATES (Con'td)

| Classification | Minimum Rate per Hour |
|---|---|
| Structural Steel Worker Helper | |
| Teamster (2 up) | |
| Teamster (4 up or more) | |
| Tool Dresser | |
| Truck Driver (under 4 tons) | |
| Truck Driver ( 4 tons to 10 tons) | |
| Truck Driver (over 10 tons) | |
| Welder (Certified - structural steel) | |
| Welder (Certified - other than structural steel) | |
| Welder's Helper | |

(b) Each class of laborer and mechanic specified in the above schedule shall receive not less than the minimum rate of wages specified therin, except that deductions from wages paid may be made as required by any laws now or hereinafter in force, in the state in which this project is situated, calling for contributions by employees from earnings to funds maintained in the administration of an unemployment compensation law under the Social Security Act. In the event that it becomes necessary to employ any laborer or mechanic whose work is not covered by any of the classifications in said schedule, he shall be paid not less than the prevailing rate of wages for the class of work done by him. Such rate shall be predetermined by the contracting officer. In case any dispute arises as to what are the prevailing rates of wages for work of a similar nature which cannot be adjusted by the contracting officer, the matter shall be referred to the Secretary of Labor for determination and his decision thereon shall be conclusive on all parties hereto.

(c) The contractor will be required to furnish identification badges for all his employees. These badges will show the employee's photograph, printed name, and signature, and will be of a design approved by the contracting officer.

(d) The contractor, in performing the work required by this contract, shall not discriminate against any worker because of race, creed, color, or national origin.

(e) The contractor agrees that the provisions of paragraph (d) above will also be inserted in all of his subcontracts. For the purpose of this article a subcontract is defined as any contract entered into by the contractor with any individual, partnership, association, corporation, estate, or trust, or other business enterprise or legal entity, which involves performance, wholly or in part at the site of the work, of some part of the work to be performed under this contract.

1-39. REPORTS TO DEPARTMENT OF LABOR. - The contractor will report monthly, and shall cause all subcontractors to report in like manner, within five days after the close of each calendar month, on forms to be furnished by the Department of Labor, the number of persons on their respective payrolls, the aggregate amount of such payrolls, the man hours worked, and the total expenditures for materials. He shall furnish to the Department of Labor the names and addresses of all subcontractors on the work at the earliest date practicable, provided that the foregoing shall be applicable only to work at the site of the construction project. Copies of all data furnished the Department of Labor shall be promptly furnished the contracting officer.

1-40. INVOICES. - The contractor shall furnish the contracting officer with copies of all invoices for the purchase of materials, supplies and plant in connection with the work to be performed under these specifications. The contractor's records shall be subject to inspection by the contracting officer to verify the accuracy and completeness of the information furnished.

1-41. COST DATA. - The Government will keep a record of the costs of the work performed under these specifications and the contractor shall permit the contracting officer to have access to his timekeeping, invoices and plant records for this purpose. The contractor shall also furnish the contracting officer ith a statement of the initial cost and date of purchase of all plant used in connection with the work.

1-42. ADJUSTMENT OF CONTRACT PRICE BY REASON OF CHANGE IN FEDERAL, STATE OR LOCAL TAXES. - The contract price will be considered to include all Federal, State and local taxes imposed prior to the date of opening bids and applicable to the undertaking. If any privilege, sales, gross receipts or other tax (exclusive of taxes on net income or undistributed profits), applicable to the undertaking and payable directly by the contractor, is imposed or changed after the date of opening bids by Federal or State enactment, then the contract price will be increased or decreased accordingly and any amount due or chargeable against the contractor as a result thereof will be adjusted on payment vouchers as separate items.

1-43. SUBCONTRACTORS. - Subcontractors and their employees shall be considered to be employees of the contractor as the term "employee" is used in these specifications.

1-44. SITE OF WORK. - The term "Site of the Work", as used in these specifications and in Articles 17 and 19 of the contract, will embrace all areas wherein field operations are conducted by the contractor in connection with this contract, including work areas, shops, yards, camps, etc., irrespective of whether such operating areas lie within the limits of work areas or rights-of-way shown on the drawings.

1-45. ASSIGNMENT OF CLAIMS. - The Act of October 9, 1940 (Public No. 811, 76th Congress) provides that Sections 3477 and 3737, Revised Statutes, shall not apply to any case in which the moneys due or to become due from the United States, under a contract providing for payments aggregating $1,000 or more, are assigned to a bank, trust company, or other financing institution, including any Federal lending agency. An assignment may be made under this contract, pursuant to the Act of October 9, 1940, cited above, and subject to the further provision stated below:

(a) Any assignment shall cover all amounts payable under this contract and not already paid and shall not be made to more than one party, except that any such assignment may be made to one party as agent or trustee for two or more parties participating in such financing.

(b) Any claim under this contract which may be assigned may be subject to further assignment to a bank, trust company, or other financing institution, including any Federal lending agency, and to similar further assignment; provided, that any such assignee shall file written notice of the further assignment together with a true copy of the instrument of further assignment with the contractor and also as provided in proviso 4 of Section 1 of the Assignment of Claims Act of 1940 (Public No. 811, 76th Congress) in respect of original assignment.

(c) No assignee shall divulge any information concerning the contract, or contained therein, except to those persons necessarily concerned with the transaction.

(d) Payments to an assignee of any claim arising under this contract shall not be subject to reduction or set off for any indebtedness of the assignor to the United States arising independently of this contract.

## 1-46. ADJUSTMENT OF PRICES FOR LABOR AND MATERIALS.

(a) The following terms used hereafter are defined as follows:

(1) "Basic hourly earnings index" shall be determined by adding monthly average hourly earnings in the "___________" industry as indicated under heading "_____________________________" in the monthly pamphlet "Hourly Wages and Labor Employment" issued by the Department of Labor for: the month in which contract time commences, the five (5) months preceding such month, and the six (6) months succeeding such month; and then dividing this total by twelve (12).

(2) "Basic materials index" shall be determined by method in (1) above, using monthly indices for item "_________________________" in the monthly pamphlet "Wholesale Prices" issued by the Department of Labor.

(3) "Monthly labor adjustment index" shall be determined from monthly average hourly earnings identified as to source in (1) above as follows: Add the average hourly earnings for the month for which adjustment is being made, the two preceding months and the two succeeding months; and then divide this total by five (5).

(4) "Monthly materials adjustment index" shall be determined by method in (3) above, using monthly indices identified as to source in (2) above.

(5) Above contract indices in (1), (2), (3), and (4) shall be computed to nearest second decimal place, taking the decimal point as located in indices issued by the Department of Labor. When third decimal place computes to 5 or over, the figure in second decimal place shall be raised to next higher figure.

(b) (1) The proportion of the contract price represented by labor, subject to adjustment in price, is accepted as ________________ per cent of the contract price.

(2) The proportion of the contract price represented by materials, subject to adjustment in price, is accepted as ____________ per cent of the contract price.

(c) (1) The labor cost for entire contract as determined in (b) (1) above shall within thirty (30) days after receipt of notice to proceed, be divided into monthly labor cost quotas, prepared by the contractor and subject to the approval of the contracting officer, for each partial or whole calendar month of the contract time beginning with the notice to proceed.

(2) The materials cost for entire contract as determined in (b) (2) above shall be similarly divided into monthly materials cost quotas within (30) days after receipt of notice to proceed.

(d) Adjustments in payments shall be obtained for each monthly cost quota as follows:- Multiply monthly cost quota by the appropriate monthly adjustment index, divide by corresponding basic index, and subtract monthly cost quota. The result shall be added to or deducted from payments to the contractor.

(e) (1) If the time for performance of this contract is legally extended by the contracting officer, there shall be immediately set up by the contractor, subject to the approval by the contracting officer, new monthly cost quotas as necessary. These new monthly cost quotas may extend back as far as any month for which adjustments in payments have not been completed, but the total of the new quotas shall not exceed the total of the old quotas for which adjustments in payments have not been completed.

(2) If there is an increase or decrease in the work originally contemplated under this contract, there shall be immediately set up by the contractor, subject to the approval of the contracting officer, new monthly costs quotas for months concerned.

(3) If liquidated damages are assessed against the contractor under the contract, such liquidated damages shall not be considered in making adjustments.

(f) The adjustment payment or deduction for any one month shall normally be included with next partial contract payment after receipt of Department of Labor indices for such month.

(g) The acceptance and final payment for work and/or materials under this contract shall be carried out as elsewhere provided in this contract, and amounts retained for the protection of the Government during construction shall be promptly paid upon final acceptance: Provided, however, that an amount, as determined by the contracting officer, for protection of the Government in adjustments not yet completed, shall be retained; and, provided further, that the release required by ___________ _______________ will contain provision excepting such adjustment payments as may become due the contractor.

(h) After final payment for basic contractual price as indicated in paragraph (g) above has been made, adjustments becoming due will be delayed until all indices necessary for completion of all adjustments under the contract are available, when one lump payment or deduction shall be made for such adjustments.

(i) In case the final adjustment in the contract price results in a net deduction from the contract price, the contractor and his sureties shall be liable for the amount thereof until it is refunded to the Government.

(j) When payment obligations under the contract exceed the contract price as a result of increases in labor and/or materials costs to the extent that available appropriations are exhausted, the Government reserves the right, without further liability to suspend further work under the contract for the account of the Government or to terminate the contract on payment of contractual obligations incurred up to the point of termination.

1-47. FINAL EXAMINATION AND ACCEPTANCE. - When all work called for under this contract has been completed, the contracting officer will make a thorough examination of the same, and, if it is found to comply fully with the requirements of the contract, it will be accepted and final payment will be made in accordance with the provisions of Article 16d of the contract.

1-48. APPROVAL. - This contract shall be subject to the written approval of the proper authorities to be designated later and will not be binding until so approved.

## SECTION II

## COFFERDAMS AND DIVERSION

### 2-01. WORK TO BE DONE. -

(a) General. - The work included under this section consists of all work required to divert water into the new canal to the Intake Works and the maintenance of an uninterrupted flow at all times. The principal items of work are (1) the construction and maintenance of cofferdams, (2) diversion and regulation of the flow through the new canal, and (3) unwatering and maintaining the working areas free from water.

(b) Scope. - Unless otherwise specified or authorized, all work on construction which forms a part of the permanent structure shall be done in areas free from water. The contractor shall construct and maintain cofferdams across the old canal and shall furnish and maintain all necessary pumps and other facilities for unwatering and keeping the working areas free from water. On completion of the work the contractor shall remove all equipment and temporary structures as specified herein, dispose of all debris, and restore the work area to a neat and sightly condition. The price bid for each item of work shall include constructing, handling, placing, maintaining and operating such work, and furnishing all materials, labor, and equipment required.

2-02. STAGES OF WORK. - The construction of cofferdams, diversion of the water and unwatering the required areas shall be governed by the following stages of work:

(a) First Stage. - The first stage will be the excavation for and construction of the spillway, the south bulkhead, the first two monoliths of the north bulkhead, and the training walls. In the spillway, the concrete around the gates and the discharge conduit downstream from the gates, as shown by the construction joints on the drawings, will be omitted in the first stage in order that the openings may be used in subsequent diversion. Compacted earth fill to be placed during the first stage will include the backfill to Elevation 210 around the north bulkhead and in back of the north training walls, all the backfill at the south end of the structure, and part of the south wing dam to the extent that suitable material is available from the excavation.

(b) Second Stage. - The second stage will include the excavation of the new canal upstream and downstream from the concrete structures, as much as possible being done in the dry. Suitable material from the excavation is to be used in the construction of the south wing dam. The last part of the second stage will be the construction of rock and earth fill cofferdams across the old canal. All the water for the power canal will thus be diverted through the new intake structure, and the cofferdams will later form the toes of the north wing dam slopes across the present channel. The completion of this stage shall coincide with the completion of stage 2 of Long Sault Dam. (See paragraph 1-06 (b) (1) ).

(c) Third Stage. - The third stage will be the excavation for and completion of the remainder of the north bulkhead.

(d) Fourth Stage. - The fourth stage will be the construction of the north wing dam, complete, and completion of the south wing dam if not previously completed. (See paragraph (b) above.)

(e) Fifth Stage. - The fifth stage will be the construction of the concrete discharge conduits and installation of the control gates and hoists. Work on the fifth stage will be undertaken when the water in the St. Lawrence River has raised high enough to pass the required power canal flow through fewer than eight bays of the Intake Works. (See also paragraph 1-06 (b) (1).) Dewatering of successive intake bays will be accomplished by installing stoplogs upstream and downstream. The discharge conduit will then be completed and the gates installed.

2-03. COFFERDAMS. -

(a) General. - Rock and earth fill cofferdams across the present power canal shall be constructed at the locations and to the lines shown on the contract drawings. Prior to placement of the rock fill, the soft foundation material shall be excavated as stated in paragraph 3-06 (a) (2). The rock and earth fill shall be placed by dumping in a manner satisfactory to the contracting officer. The earth fill material may be obtained from the borrow area shown on the drawings at the locations directed by the contracting officer. Rock fill may be obtained from required excavation and borrow pits. Fifty percent of the rock fill material shall be pieces weighing over 150 pounds.

(b) Measurement and Payment. - Measurement for payment will be made between the foundation line and the lines shown on the drawings. Payment for hauling and placing earth fill will be made at the contract unit price per cubic yard for "Earth Fill; Cofferdams." Payment for furnishing and placing rock fill, regardless of source, will be made, at the contract unit price per cubic yard for "Rock Fill; Cofferdams".

2-04. MASSENA CANAL RELOCATION. - Excavation for the new canal as specified in paragraph 3-06 (a) (2) shall be started following the completion of the first stage construction of the intake structure and completed prior to the closing of the present intake by the cofferdams. As much as possible of the excavation shall be finished and riprap placed before the opening of the canal for passage of water. Suitable material from the excavation may be placed directly in the wing dams of the intake structure. Payment for this work will be made as provided in paragraph 3-07.

2-05. UNWATERING. -

(a) General. - The area enclosed by the cofferdams shall be unwatered by suitable pumps furnished by the contractor prior to construction of the north wing dam. All other work areas shall also be unwatered by pumping in order to maintain them free from water insofar as possible. The inflow of water from Dodge Creek into the excavation area of the diversion canal shall be removed by pumping to insure as dry a condition as possible for construction purposes.

(b) Payment. - Payment for unwatering will be made at the contract lump sum price for "Unwatering Foundations."

2-06. REGULATION. -

(a) General. - From the time of closure of the old canal in the second stage to the completion of the fourth stage the contractor will be required to regulate as directed, the discharge of water through the spillway. This shall be done by placing or removing stop logs so as to maintain the proper level in the power canal. During the fifth stage and until completion of the job, regulation will be obtained by automatic operation of the gates where they have been installed, or by stop logs where the gates have not been installed, as directed by the contracting officer.

(b) Payment. - No separate payment will be made for regulating the discharge of water through the spillway, but the cost of such work shall be included in other contract prices.

2-07. STOP LOGS. -

(a) Downstream Stop Logs. - Before the start of the fifth construction stage the contractor shall furnish and place the downstream stop log in the slots or in storage, as directed by the contracting officer. (See paragraph 11-16 (a).)

(b) Temporary Upstream Stop Logs. - The contractor shall furnish and attach the timbersheathing to each of the steel frames furnished by the Government (See paragraphs 7-06 and 11-16 (b)). This work shall be complete before the start of the second construction stage.

## SECTION III
## EXCAVATION, FOUNDATION PREPARATION, AND GROUTING

3-01. CLEARING AND GRUBBING.

(a) Clearing. - The entire work areas as shown on the contract drawing, sheet No. 2, shall be cleared as specified below.

(1) Foundation and Borrow Areas. - The excavation areas for the canal and embankments and the borrow areas shall be cleared of all trees, stumps, brush, fences, buildings, and any other objectionable material or structures.

(2) Spoil Areas. - In areas to be covered by spoil, trees shall be cut off at elevations not higher than 4 feet below the top o the spoil dump.

(3) Reservoir Areas. - Areas upstream from the Intake Works, within the limits indicated on the drawing, and below elevation 250, shall be cleared of trees, brush, fences, buildings, and any other objectionable materials or structures. All trees shall be cut off 2 feet above the ground surface except that no stumps shall remain above elevation 230. Where trees stand on ground between elevation 230 and 250 they shall be cut off flush with the ground.

(4) Other Areas. - Other areas not included in the above within the work areas shown shall be cleared only to the extent necessary for the contractor's camp, storage areas, shops, plant, and the conduct of the work.

(b) Grubbing. - Foundation areas for the embankments shall be grubbed of all stumps, perishable material, and roots greater than 1½ inches in diameter to a minimum depth of four feet below the original ground surface.

(c) Disposal. - All trees, stumps, roots, brush, falling timber, buildings, and other debris cleared within the areas indicated above shall be burned, buried in spoil areas, or otherwise completely removed from the site to the satisfaction of the contracting officer. Disposal in the river or canal of trees, stumps, roots, and other harmful material will not be permitted, and no material shall be piled where it may be washed away by high water. The contractor shall be responsible for any damage done by fire, and shall at no time leave a fire unattended until it has been fully extinguished.

(d) Measurement and Payment. - No separate payment will be made for clearing and grubbing but the costs for such work shall be included in the contract priced for other items of work.

3-02. EXCAVATION REQUIREMENTS.

(a) Excavation and stripping shall be carried to the lines and grades shown on the drawings or as directed by the contracting officer. Excavation and foundation preparation for the various sections of the concrete structures and wing dams shall be performed in accordance with paragraph 3-06, 3-08, 3-09, and 3-10 of these specifications, or as otherwise directed by the contracting officer.

(b) Borrow Pits. - The designated borrow areas to obtain embankment materials are indicated on the drawings (see paragraph 1-16). It is estimated that in the designated borrow areas and in the required excavation there is sufficient quantity of suitable material for the compacted fill sections of the embankments, but if, in the opinion of the contracting officer, additional borrow pits are required, they will be furnished without cost to the contractor. Within the limits of the borrow area indicated on the drawing there exists a small superficial deposit of sand and gravel. (See paragraph

3-07(a)(2)).

(c) Rock Sources. - The contractor shall furnish all rock for riprap and rock fill required in excess of that obtained from the excavations at the site.

3-03. CHARACTER OF MATERIALS TO BE EXCAVATED. - The location and logs of borings, test trenches, and test pits referred to in paragraph 1-18(a) made by the United States to determine the character of materials to be encountered and removed or to be used in the permanent structures are shown on the drawing or are available for inspection at the U.S. Engineer Office, Massena, New York. The United States does not guarantee that other materials will not be encountered nor that the proportions of the several materials will not vary from those indicated by the explorations. (see paragraph 1-18(a)).

3-04. EXCAVATION IN BORROW PITS AND STOCK PILES.

(a) Borrow Pits. - The contracting officer will specify the location at which borrow excavation will be made within the borrow areas. The specified areas shall be cleared and grubbed as stated in paragraph 3-01, and stripped to a depth of 18 inches or as otherwise directed by the contracting officer. All materials from stripping shall be finally disposed of in the excavated portions of the borrow areas or used in Class III fill. The depths of cuts and lifts and the disposition of the excavated materials may require the contractor to change the locations and depths of his excavating operations whenever such change is, in the opinion of the contracting officer, necessary to obtain the proper quality of material. The excavations shall be worked so that the materials are mixed in the process of excavation. Excavation within the borrow pits shall be in a manner to produce drainage of the material if the ground water table is above the elevation of the excavation. After the excavation is completed, excavated surfaces shall be graded to a smooth and pleasing appearance as directed by the contracting officer and each borrow area shall be so graded that the final surface area shall blend into the surrounding topography and all surface water will readily drain therefrom. (see also paragraph 1-16). The contractor shall construct and maintain all connecting roads required from the borrow areas to the place of disposal.

(b) Stock Piles. - Rock materials from stock piles shall be obtained in a manner satisfactory to the contracting officer. After the excavation of the stock pile of rock is completed, the remainder of the material shall be gathered and neatly piled as directed by the contracting officer.

3-05. CLASSIFICATION OF FOUNDATION AND CANAL EXCAVATION.

(a) Rock Excavation. - All bedrock required to be excavated which, in the opinion of the contracting officer, cannot be removed without continuous and systematic blasing, and all boulders and loose rock two cubic yards in volume or greater will be classed as rock excavation.

(b) Common Excavation. - All other material will be classified as common excavation, including boulders and loose rock less than two cubic yards in volume. (See paragraph 3-07(b)).

3-06. REMOVAL AND DISPOSAL OF EXCAVATION.

(a) Removal. - All materials shall be removed to the lines and grades as indicated on the drawings, or as otherwise required by the contracting officer. (For the limits of each structure listed below see paragraph 1-03 and the drawings forming a part of these specifications).

(1) Excavation for Concrete Structures. - Excavation for the concrete structures shall be carried to a satisfactory firm foundation as

determined by the contracting officer after completion of sub-surface explorations. The firm rock line shown on the drawings is only approximate and is not guaranteed. Should actual firm rock be encountered at a higher or lower elevation than the approximate firm rock line shown on the drawings, no change will be made therefor in the contract unit prices.

(2) Excavation for the Canal. - Earth excavation for the canal shall be conducted in a manner to obtain suitable earth fill material for the south wing dam. During the first stage of excavation, all the material above the water line and between the end plugs of the canal shall be excavated. Areas from which suitable earth fill materials may be obtained for embankments shall be stripped as directed by the contracting officer. The depths of cuts and lifts and disposition of the excavated materials may require the contractor to change the location and depths of his excavating operations whenever such change is, in the opinion of the contracting officer, necessary to obtain the proper quality of material. The excavation shall be worked so that the materials are mixed in the process of excavation.

(3) Excavation for Embankments. - Embankment areas shall be stripped and excavated to lines and grades, and slopes as shown on the contract drawings or as directed by the contracting officer. The contractor shall unwater all excavation areas to produce a dry condition suitable for placing embankment as determined by the contracting officer. Explorations indicate that it will be necessary to remove silt & clay deposits in the channel area for the north wing dam (including cofferdams) foundation, certain areas for dike foundation. Should excavation be required to a higher or lower elevation than that indicated on the drawings, as determined by the contracting officer, no change will be made therefor in the contract unit prices.

(b) Disposal. - The foundation excavation materials shall be disposed of as follows unless otherwise directed by the contracting officer.

(1) Materials Excavated for Canal and Concrete Structure. - All material excavated for the construction of the canal and concrete structure which is suitable for earth embankments, as determined by the contracting officer, shall be placed directly in the earth sections of the south wing dam as backfill around the concrete structures. All material not suitable for backfill and the embankments of the wing dam shall be disposed of in the spoil area shown on the contract drawings in a manner and to an elevation satisfactory to the contracting officer.

Rock obtained during the excavation for concrete structures which passes the specifications for Class A and Class B riprap (see paragraph 4-08) or for cofferdams shall be placed directly in the rock fill sections of the wing dams and/or in stock piles.

(2) Material Excavated for Embankments. - Material excavated from foundation areas for the embankments (see paragraph 4-01) and determined usable by the contracting officer shall be placed directly in the earth sections of the wing dams in accordance with the specifications stated in Section IV. All material excavated and determined waste by the contracting officer shall be placed in spoil areas shown on the plans or as approved by the contracting officer.

3-07. MEASUREMENT AND PAYMENT FOR EXCAVATION.

(a) Measurement.

(1) A survey of the channel site and ground surface for foundation and canal excavation will be made prior to commencement of work and measurements of excavation will be based on this survey and on the

classifications specified in paragraph 3-05. Measurement for common excavation will be made between the ground surface and the slope and grade lines shown on the drawings or as modified by the contracting officer, or to the natural rock surfaces encountered in such excavation.

(2) A survey of all borrow areas for earth fill will be made prior to the removal of material. Measurement of excavation for embankment materials for payment will be based on this survey, and a final survey of the completed excavation. If the contractor removes the superficial deposit of sand and gravel mentioned in paragraph 3-02(b) for other sections of the embankment, the survey will be made after such material is removed. No separate payment for excavating sand and gravel will be made.

(3) Measurement for rock excavation will be made for the actual quantity excavated within the slope, structure, and grade lines shown on the drawings, or such modifications of these lines as directed by the contracting officer. No payment will be made for any rock excavation carried below or beyond these lines by unnecessary drilling and blasting and all rock thus removed, shall be replaced with concrete at the expense of the contractor.

(4) The excavation slope lines shown on the drawings do not represent actual slopes necessary and are not guaranteed by the Government as safe slopes for making the required excavations. The actual slopes required for safety shall be determined by the contracting officer and may be greater or less than shown.

(b) Payment.

(1) Payment for all required foundation excavation shall include the cost of stripping and excavating, transporting and disposal as required under paragraphs 3-01 and 3-06 and will be made at the respective contract unit prices per cubic yard for "Excavation; Common", and "Excavation; Rock".

(2) Payment for common excavation which in the opinion of the contracting officer cannot be removed by a 2½ cubic yard power shovel without continuous and systematic blasting will be made at twice the contract unit price per cubic yard for "Excavation; Common".

(3) Payment for all earth embankment materials excavated from the borrow pits including material stripped from the surface will be made at the contract unit price per cubic yard for "Excavation, Borrow", which unit price shall include all costs of draining, excavating, transporting and dumping the suitable fill material in the embankments; and the disposal of the stripping material, and the cost of all operations attendant thereto.

(4) No separate payment will be made for rock excavation from stockpiles.

3-08. FOUNDATION PREPARATION - ROCK. - Foundation excavation for the concrete structures shall be carried to the lines and grades as indicated on the plans and/or to sound, firm ledge rock, free from open horizontal seams or disintegrated portions. Blasting against surfaces which will form the final surface will not be permitted, see paragraph 3-10. The foundation shall be prepared by barring, picking, wedging, or similar methods which will leave the rock of the foundation in an entirely sound and unshattered condition. The surface of the rock shall be left clean and rough to provide a proper bond between the rock and the concrete. All water shall be removed from the final foundation, which shall be moistened as required by the contracting officer prior to initial placement of grout. The contractor will be required to drill exploratory core holes as described in paragraph 3-12 in the foundation to determine the suitability of the bedrock. Payment for foundation preparation will be included in payment for rock excavation.

3-09. LINE DRILLING.

(a) The vertical rock faces indicated on the drawings or as otherwise required by the contracting officer shall be made with a channeling machine, by drilling and broaching or by close line drilling. Rock excavation adjacent to channeled faces shall be removed in shallow lifts and short sections, and the channeled face remaining shall be of undisturbed rock.

(b) Measurement for line drilling will be made along the vertical surfaces indicated on the drawings or established by the contracting officer. Payment for channeling, drilling and broaching or close line drilling will be made at the contract unit price per square foot of vertical surface for "Line Drilling". Payment for the rock removed will be made as specified in paragraph 3-07.

3-10. BLASTING FOR EXCAVATION. - Blasting will be permitted only when proper precautions are taken for the protection of all persons, the work and property, and any damage done to the work, or property by blasting shall be repaired by the contractor at his own expense. Caps or other exploders or fuses shall in no case be stored or kept in the same place in which dynamite or other explosives are stored. All operations of the contractor in connection with the transportation, storage and use of explosives shall be subject to the approval of the contracting officer, and the contractor shall be liable for all injuries or deaths of persons or damage to property caused by blasting or explosives. All necessary precautions shall be taken to preserve the rock outside the lines of excavation in sound condition. Blasting may be done only to the depth, amount and extent approved by the contracting officer. Approval of the method of blasting by the contracting officer, as specified in this subparagraph will not relieve the contractor of his responsibility in blasting operation, and no payment will be made for any rock required to be excavated outside of the limit lines indicated on the drawings or below the grade lines established in the field, or modifications thereof directed by the contracting officer, solely due to injury caused by the overshooting, improper blasting or carelessness on the part of the contractor, and all rock thus removed shall be replaced by concrete at the expense of the contractor, including the payment for all cement used in such concrete and furnished by the United States. No blasting shall be done within one hundred (100) feet of concrete which has been in place less than seven (7) days.

3-11. DRILLING EXPLORATORY AND GROUT HOLES.

(a) General. - For the purpose of canvassing bids, the approximate extent of a tentative program for drilling exploratory and grout holes is outlined in these specifications. The Government reserves the right, however, to alter the location and depth of the exploratory and grout holes, and no change will be allowed in the contract unit prices because of such alteration. The contractor shall, at the proper contract unit prices, drill exploratory and grout holes at such locations and at such inclinations not to exceed twenty (20) degrees from the vertical, and such depths, subject to the limitations hereinafter specified, as may be required by the contracting officer.

(b) Method of Rock Core Drilling. - Core drilling through rock shall be done with standard core drilling equipment using diamond or alloy bits designed to furnish complete standard cores a minimum of 2 inches in diameter from holes 3 inches in diameter. The contractor shall run his drills at such speed as will insure satisfactory core recoveries, and the contracting officer may require, without compensation, the redrilling of those holes from which the cores are unsatisfactory if the contractor's operations are at fault.

### 3-12. EXPLORATORY CORE HOLES.

(a) General. - The foundation area to be covered by the concrete structures and areas adjacent thereto shall, after removing overburden, be further explored by rock core drilling as specified in paragraph 3-11. The layout of holes shall be as directed by the contracting officer. These holes in the foundation rock are intended to determine the location of suitable rock for the foundation of the structure and wing dams. Concreting shall not be commenced in any section until after the contractor has received written approval of the foundation for placing concrete for each monolith.

(b) Rock Cores. - Core boxes for storing the 2-inch cores, see paragraph 3-11(b), shall be furnished at the site by the contractor. The cost of the boxes and spacers shall be included in the contract prices. All samples shall be in the custody of the contractor until transported from the site by a representative of the contracting officer, and while in his custody shall be protected. All boxes shall be of pine of similar soft lumber of light weight, non-warping and capable of holding screws without splitting. They shall be neatly and substantially constructed with suitable partitions, with the top of the box hinged and with suitable hasp fasteners. Partitions in the boxes shall run lengthwise, be securely fastened and shall be approximately 1/8 inch farther apart than the diameter of the rock core to be placed in the box. Spacers to separate the rock core obtained by each run shall be soft wooden blocks to fit between the core box partitions and 1½ inches in length. The core boxes shall be of uniform size 4 feet in length and approximately 12 inches in width, and shall meet with the approval of the contracting officer. . All cores shall be neatly arranged in the sequence in which they are removed from the hole, and shall be properly identified.

(c) Filling With Grout. - All exploratory core holes shall be filled with grout consisting of sand and cement of such mixture as determined by the contracting officer. Sand for grouting shall be as specified in paragraph 3-13(e). The holes shall be filled with grout by means of equipment for pressure grouting as described in paragraph 3-13(d). In filling the exploratory core holes no leakage tests are required and the hole being filled shall not be sealed.

(d) Payment. - All measurements for payment shall be made by or in the presence of an authorized representative of the contracting officer. Holes will be measured for payment for the number of linear feet drilled from the rock surface to the bottom of the hole. Payment will be made at the contract unit price per linear foot for "Drilling 3-inch Exploratory Holes", which payment per linear foot for this shall include all work in connection with drilling, core recovery, core boxes, and storage at the site, and for mixing and placing the grout filling. Cement will be furnished by the Government and the sand will be paid for at the contract unit price per cubic foot for "Sand in Grout".

### 3-13. PRESSURE GROUTING FOUNDATION.

(a) General. - A grout curtain cut-off shall be provided as shown on the plans. This shall be done by pressure grouting a line of holes drilled from the floor of the grouting gallery in the north and south bulkheads and throug the base of the spillway. All grouting shall be done before the area of the section being grouted is flooded. The holes through the concrete may be obtained by percussion drilling or by placing 4 inch pipe prior to concreting. Where drilling of the wing dam areas passes through overburden on the rock, 4-inch iron pipes must be provided so that drilling and grouting may be carried on without disturbing the overburden. These pipes must be filled with grout and left in place after grouting is completed. The core drilling shall be performed and 2-inch cores recovered as specified in paragraph 3-11. The contracting officer may require approximately 50 percent of the cores from grouting holes to be preserved and stored in core boxes. The core boxes shall be constructed and cores stored as specified in paragraph 3-12(b). Payment for core boxes in which cores from grouting holes are stored will be made as a separate item. The contractor will be required to protect the concrete surfaces during all drilling and grouting operations and no separate payment will be made for such protection. When the drilling of each hole has been completed, the hole shall be protected from being clogged or obstructed until it is grouted. Any hole that becomes clogged or obstructed prior to grouting shall be opened up to the satisfaction of the contracting officer, and no separate payment will be made therefor.

(b) Pressure Testing. - Before any hole is grouted it shall be pressure tested with water for leakage at intervals of 10 feet throughout the full depth of the hole. The contractor shall furnish the necessary equipment and make the tests. The equipment shall provide capacity sufficient to test the grout holes at pressure up to 150 pounds per square inch. A suitable gage shall be installed in the pressure line at the hole being tested so that pressures in the hole will be indicated at all times. A water meter reading directly to 0.1 cubic foot per minute shall be installed in the pressure line to measure the leakage from the hole. The pressure shall be varied with the depth at the direction of the contracting officer. From the test results, the contractor shall furnish information indicating the location and amount of each leakage. Payment for pressure testing will be included in the contract unit price for "Drilling Foundation Grout Holes in Rock".

(c) Procedure.

(1) The first line of grouting holes shall be drilled at intervals of about 50 feet . The holes shall be drilled and cores recovered, as specified above, to a depth of 60 feet or more as directed by the contracting officer. These holes shall be pressure tested as specified in paragraph3-13(b) above.

(2) The second set of holes shall be drilled as specified above on 10-foot centers between the first set, and to a depth indicated as necessary by results obtained from the first set of holes and as directed by the contracting officer. The holes on 10-foot centers shall be pressure tested and the leakage measured as specified above.

(3) All the holes on 10-foot centers shall next be thoroughly washed out and grouted according to the procedure specified in paragraph 3-13 (e). Should seams connect between any adjacent grout holes these holes shall be interconnected and simultaneously washed and then simultaneously grouted. If more than three holes join any one seam, seals and connections will be required, of a design approved by the contracting officer, to simultaneously grout the holes.

(4) After the grout holes on 10-foot centers have been satisfactorily grouted and not sooner than 48 hours thereafter, test holes shall be drilled midway between and to the same depth as the adjacent 10-foot holes. These test holes shall be drilled, tested, and if found to leak more than approved by the contracting officer, they shall be grouted by the same method

as the holes on 10-foot centers.

(5) This method of drilling and grouting shall continue until the grouting has been accepted as completed, i.e., when a hole is drilled and found necessary to grout, holes shall be drilled each side of the grouted hole at one-half the previous interval, and the same testing, washing, and grouting procedure shall be followed until no more leakage is observed or as otherwise directed by the contracting officer.

(d) Grouting Equipment to be Used. - The equipment to be used for mixing and injecting the grout shall be subject to the approval of the contracting officer. The grouting unit shall provide:

(1) A grout mixer for mixing the ingredients.

(2) A suitable water meter with straight-reading register reading to the nearest 0.1 cubic foot for measuring the mixing water.

(3) A water tank for auxiliary water supply to be used for pressure testing, flushing pumps, lines, and hole.

(4) A mechanically agitated sump to prevent the segregation of ingredients after mixing and to maintain a supply during the mixing period.

(5) Two duplex piston displacement grout pumps so piped and assembled as to provide interchangeable, continuous, and effective injection of grout at any desired pressure, not to exceed 250 pounds per square inch.

(6) Air compressors of suitable capacity, water pumps, and auxiliary equipment. The mixer and sumps shall each have a volume of not less than 15 cubic feet. The assembled unit shall allow the injection of 150 cubic feet of solids per hour at 150 pounds per square inch pressure, if desired. The grouting equipment shall be maintained in a manner satisfactory to the contracting officer and so as to insure continuous and effective performance during any grouting operation. Circulating grout lines shall be not less than 1½ inches in diameter and are to be controlled by suitable valves in the header and piping so that all or part of the grout can be injected into the hole, or all or part returned to the sump. A suitable pressure gage shall be provided at the hole as well as at the pump for indicating the pressure during the injection of grout. The pressure gage shall be installed in the header near the hole being grouted. Bypassing of the grout back to the sump tank shall be near the hole being grouted and not at the machine. Grout stops or packers and hole connections are to be provided which shall consist of a double sealing unit 5 feet long. The expanding seals at each end shall be composed of rubber and shall have a length of 6 inches by 3 inches in diameter as directed by the contracting officer. Miscellaneous calking tools and hammers and necessary labor for calking will be furnished by the contractor as directed by the contracting officer.

(e) Composition of Grout and Method of Placement. - Grout shall consist of a mixture of neat Portland cement and water in proportions as directed by the contracting officer, or sand or rock flour may be mixed with grout in proportion not to exceed 1 cement to 3 sand or rock flour. The type and mixture of grout to be used will be determined by the nature of the seams to be grouted and as directed by the contracting officer. Sand, if used, shall be of such fineness that 100 percent will pass a No. 28 standard sieve and 25 percent will pass a No. 100 sieve. Rock flour, if used, shall be dust obtained by crushing dolomite rock and it shall be at least as fine as specified above for sand. Cement for grouting will be furnished by the Government in paper bags, see paragraph 1-10(d). Prior to pressure grouting, all grout holes shall be sounded and, if necessary, shall be thoroughly washed and cleaned with water under continuous pressure or by compressed air and water in a manner which will permit free overflow of waste water, by inserting a smaller pipe and introducing the wash water at the bottom of the hole. The speed of operation of the grout pump and the grouting pressure will be as directed by the contracting officer. In general, it is expected that pressures up to 150 pounds per square inch will be required for the deeper sections of the holes, while lower pressures will be used on the upper zones. Grouting shall be continued until the hole takes the grout mixture at a rate of less than one cubic foot in 10 minutes under the required grouting pressure, and the grouting of any hole shall be discontinued when directed by the contracting officer. The contracting officer may require that the grouting of any holes be temporarily suspended if work is proceeding in an unsatisfactory manner, and the hole protected by suitable means until grouting is resumed. In the event of an unavoidable delay during grout injection, the contractor shall supply water at not less than the specified grouting pressure for application to the hole as directed by the contracting officer. When the grouting of any hole has been commenced, it shall be continued until completion, unless otherwise directed by the contracting officer. After grouting operations for any hole have been completed and the grout set, or if the rock about any hole is in such sound condition that pressure grouting is not necessary, the hole shall be completely filled with grout. When a hole during the grouting procedure shows back pressure it shall be capped or otherwise sealed.

(f) Measurement and Payment.

(1) Measurement for payment of holes in concrete will be from the plane of entry of the drill at the concrete surface to the bottom of the concrete. Measurement for payment for holes in rock will be from the plane of entry of the drill at the rock surface or at the surface of the overburden to bottom of hole. Payment for drilling grout holes in concrete and rock will be made at the contract unit price per linear foot for "Drilling Foundation Grout Holes in Concrete" and "Drilling Foundation Grout Holes in Rock", respectively, which payment shall include drilling, furnishing 4-inch pipe through overburden, pressure testing, protection of the completed hole and all costs in connection therewith. If the contractor uses 4-inch pipe for the holes through concrete in lieu of drilling he will be paid for such holes as are authorized to be used at the same rate as though the holes were drilled.

(2) Core boxes that may be required to store cores from grout holes will be paid for at the contract unit price each for "Core Boxes", which payment shall include all costs for transportation and storage in connection therewith.

(3) Providing Pressure Grouting Equipment. - Payment for providing pressure grouting equipment as specified in paragraph (d) above will be made at the contract lump sum price for "Providing Pressure Grouting Equipment".

(4) Payment for grouting will be made at the contract unit price per cubic foot for "Pressure Grouting". The volume of grout will be considered to be equal to the volume of cement and sand or rock flour used. This payment shall include washing and jetting of grout holes, and all materials, equipment, and labor necessary, except that cement will be furnished by the United States and sand or rock flour will be paid for separately. No payment will be made for grout lost due to improper anchorage of grout pipes or connections, nor for grout rejected by contracting officer because of the improper mixing.

(5) Payment for furnishing sand or rock flour used in grouting will be made at the contract unit price per cubic foot for "Sand in Grout"

or "Rock Flour in Grout".

### 3-14. FOUNDATION DRAINS.

(a) Drain pipes. - Prior to the placing of concrete, 8-inch black steel pipes shall be set in the foundation of the bulkheads in vertical or inclined positions not to exceed 20 degrees inclination from the vertical, as shown on the drawings, or as otherwise directed by the contracting officer. Pipes shall be adequately supported during the concreting operations to preserve the required alignment. Covers and drains shall be furnished and installed as shown on the drawings.

(b) Drain Holes. - Drain holes 6 inches in diameter shall be drilled through the drain pipes after foundation grouting has been completed, to depths as directed by the contracting officer, but not to exceed 100 feet below the bottoms of the pipes.

(c) Measurement and Payment. - Payment for furnishing and installing drain pipes including covers will be made at the contract unit price per pound for "Pipe; Black Steel". Payment for drilling drain holes will be made at the contract unit price per linear foot for "Drilling 6-inch Foundation Drains". Payment will be made only for the linear feet drilled below the bottoms of the drain pipes.

### 3-15. DRILLING 6-INCH CONCRETE CORES.

(a) General. - The contractor shall drill holes in the concrete at such locations and to such depths as may be directed by the contracting officer in order to obtain concrete cores 6 inches in diameter in lengths satisfactory for testing. A tolerance of ¼-inch will be permitted in the diameter of the cores. The contractor shall mark each core with black paint giving location and elevation. Upon completion of drilling, the contractor shall refill the hole with well rodded concrete of the same mix and water content as that from which the core was taken.

(b) Measurement and Payment. - Payment for drilling 6-inch concrete cores and for refilling holes with concrete will be made at the contract unit price per linear foot for "Drilling 6-inch Concrete Cores", for actual core lengths drilled and recovered. The quantity shown in the bidding schedule for "Drilling 6-inch Concrete Cores" is given only for the purpose of canvassing bids and the Government does not guarantee that any of this work will be required or that the quantity will be limited to the amount estimated.

## SECTION IV

## EMBANKMENTS, BACKFILL, AND PROTECTION STONE

4-01. DEFINITION. - The term "Embankments" as used in this section includes the earth fill of the wing dams; the compacted earth backfill around the concrete structures; the sand and gravel backing, riprap protection, and filter blankets of the wing dams; the rock and earth fill for the cofferdams; and all other specified or directed fill and slope protection.

4-02. GENERAL PROVISIONS.

(a) Lines and Grades. - The embankments from station 2+60±to 27+50± shall be constructed to the lines and grades shown on the drawings or otherwise required by the contracting officer. The embankment from station 27+50± to 45+00 shall be constructed in accordance with the plans prepared by the contracting officer after further investigations and studies are made. The contracting officer reserves the right to change the foundation widths, change the slopes and dimensions of the embankments, change the dimensions and slopes of the foundation cut-off trenches and change the shape and thickness of the dumped riprap protection and make such other changes as future studies and conditions on the work indicate as necessary for the construction of a safe and permanent structure as determined by the contracting officer. Changes in quantities of materials resulting from changes in sections shall be no cause for claims of increased contract unit prices.

(b) Materials. - Materials for the various sections of the embankment shall conform to the respective requirements specified in the following paragraphs of this section. No brush, roots, sod, and perishable or objectionable materials, as determined by the contracting officer, shall be placed in the Class I and Class II compacted earth fill. Any objectionable material placed in the embankments shall be removed by the contractor as directed by the contracting officer, without cost to the Government. The suitability of each part of the foundation for placing embankment materials thereon and of all materials for use in an embankment will be determined by the contracting officer. No materials shall be placed in Class I and Class II compacted earth fill when either the materials or the foundation on which they are to be placed is frozen.

(c) Conduct of the Work. - The contractor shall at all times maintain the embankments in conformity with paragraph 4-04 (c) and in a manner satisfactory to the contracting officer until the final completion and acceptance of all work under the contract. The contractor may be required to suspend work at any time when, in the opinion of the contracting officer, satisfactory work cannot be done on account of rain, floods, cold weather, or other unsatisfactory conditons. Any approved embankment material which is lost or rendered unsuitable after being placed in an embankment and before the completion and final acceptance of the work, due to causes that, in the opinion of the contracting officer, are avoidable, or under the control of the contractor, shall be replaced by the contractor in a manner satisfactory to the contracting officer and without cost to the Government. The contracting officer may require the contractor to remove without cost to the Government any material placed by the contractor outside of specified slope lines.

(d) Order of Work. - The contractor shall be required to organize the work so that suitable rock and earth fill materials obtained from the excavations for the canal and for the foundations of concrete structures may be placed directly in the south wing dam or backfill around the concrete structures.

## 4-03. PREPARATION OF FOUNDATION FOR EMBANKMENT.

(a) General. - The foundations for the embankments shall be stripped and excavated as specified in Section III. The test pits, stump holes and other excavated areas, depressions and cavities within the limits, required to be stripped shall be filled with compacted earth as directed by the contracting officer. The earth fill shall be placed in layers, moistened and compacted in accordance with paragraph 4-04. As the fill is brought up, the side slope of the cut or hole shall be scarified, if in the opinion of the contracting officer, it is required, in order to provide a bond between the fill and the original ground material. The sides of all holes shall be broken down if necessary so as to flatten out the slopes, and the hole then filled with approved material and properly rolled or tamped in place. Immediately prior to placing materials in the embankments and wing dams, the entire foundation, except areas to be covered by Class III fill and by sand and gravel filter, shall be scarified to a depth of 4 inches. A 4-inch layer of embankment material shall be spread and compacted as specified for Class I fill in paragraph 4-04 (e). The foundation upon which fill is placed shall be in a suitable dry condition, as determined by the contracting officer.

(b) Measurement and Payment. - Payment for the fills in the foundation areas indicated above, including the spreading, rolling and wetting where required will be made at the contract unit price per cubic yard for the applicable class of fill as indicated in the Schedule of Bid Items. No payment as a separate item will be made for other work necessary for the preparation of the foundation except for the unwatering, but the cost of these items shall be included in the contract unit prices for the other items of work connected with the embankments.

## 4-04. EARTH FILL.

(a) General. The earth sections of the wing dams between stations 2+60 and 27+50 **shall be constructed by Class I and Class II compacted fill as** shown on the drawings. The center section of the wing dams shall be composed of Class I compacted fill, rolled and compacted as specified in paragraph 4-04(e) **below.** Upstream and down stream sections of the wing dams and backfill shall be composed of Class II compacted fill compacted as specified in paragraph 4-04 (e). Backfill within 50 feet of the bulkheads shall be composed of Class I compacted fill. The wing dam between station 27+50 **and** 45+00 will be composed of either Class I and Class II fill or Class II and Class III fill. If Class III fill is incorporated in the design, it shall be placed as specified in (j) below.

(b) Material for the Class I and Class II compacted earth fills, including backfill around the concrete structures, shall be secured from the designated borrow areas in the manner specified in paragraph 3-04, from the excavations for the construction of the canal and concrete structures, and if directed by the contracting officer, from excavation for the foundation cut-off trenches for the wing dams. The materials for both Class I and

Class II compacted fill in general will be a well graded clayey or silty sand and gravel. No stones which would be retained on a 6-inch screen will be permitted in the Class I compacted earth fill. No stones which would be retained on an 8-inch screen will be permitted in the Class II compacted earth fill. Should stones of such size be found in the otherwise approved earth fill embankment materials, they shall be removed by the contractor. Suitable stones removed may be used for riprap as specified in paragraph 4-08. Each load of material to be placed in either Class I or Class II compacted earth fill shall be the equivalent, as nearly as practicable, of a mixture of materials obtained from an approximately uniform strip or cutting from the full height of a lift in excavation. The combined excavation and embankment placing operations shall be such that the materials when compacted in the fill will be blended sufficiently to secure the greatest homogeneity and desired density.

(c) Placement. - The distribution and gradation of materials throughout the Class I and Class II compacted earth fill sections of the embankments shall be such that the embankments will be free from lenses, pockets, streaks or layers of materials differing materially in texture or gradation from the surrounding material. The dumping of successive loads of earth fill materials from the different parts of the borrow pits, or required excavations shall be at locations in the embankment as directed by the contracting officer, and for this purpose, the contracting officer may direct the points in the embankments where individual loads of material shall be deposited, to the end that the more pervious material shall be placed in the downstream section of the wing dams. After dumping, the materials shall be spread by bulldozers or other approved methods in approximately 8-inch layers over the prepared foundation or fill. Materials within 18 inches of concrete walls and in other areas where compacting by rolling is impracticable as determined by the contracting officer, shall be spread in layers 4 inches in thickness before compacting. All layers shall extend at an approximately uniform elevation over the entire width of the cross section of the embankment and for the entire length of the section under construction unless otherwise directed by the contracting officer. The top surfaces of the Class I and Class II earth fill sections during construction shall be kept crowned with grades not less than 2 nor more than 4 percent, so that the surface of the fill will drain freely toward the slopes. The surface of the fill shall be maintained at all times in such a manner that no water pockets will be formed under any weather conditions. If work is stopped on any part of the Class I compacted earth fill or backfill for a period of time, the area to remain standing shall be rolled with a smooth-faced roller to prevent loss of moisture and to facilitate drainage. If, in the opinion of the contracting officer, the rolled surface of any layer of any section is too smooth to bond properly with the succeding layer or adjacent section, it shall be roughened or loosened by scarifying to the satisfaction of the contracting officer before the succeeding layer is placed thereon. Ruts in the surface of any layer shall be filled in a manner satisfactory to the contracting officer.

(d) Moisture Control.

(1) The material in each layer of Class I and Class II fill while being compacted shall contain moisture within a few percent of the optimum, as determined by the contracting officer, for the compaction desired. Prior to and during construction, the contracting officer will establish the limiting ranges of moisture contents for materials to be compacted in Class I fill and Class II fill. The moisture content shall be uniform throughout the layer. If the application of water is necessary, it may be done either at the borrow area or at the embankment. Wetting at the excavation area shall be supplemented as required by sprinkling in place on the embankment.

if in the opinion of the contracting officer it is necessary. The contractor shall maintain adequate facilities to provide the amount of water required.

(2) No layer of material shall be placed if the moisture content of the exposed surface on which it is to be placed is not within the range established by the contracting officer. The contractor shall correct the moisture content of the compacted layer if the moisture content is not within the required limits.

(e) Compaction. - Class I fill and Class II fill shall be rolled and compacted with the equipment listed in paragraph (f) below. Each layer of Class I fill shall be compacted by not less than 6 passes or trips and each layer of Class II fill shall be compacted by not less than 2 passes or trips of a sheepsfoot roller. In areas within 18 inches of concrete walls and other areas where rolling operations are impracticable, as determined by the contracting officer, compaction shall be obtained with power tampers of a type approved by the contracting officer to give compaction equal to that required for the adjoining compacted earth fill. Each pass of a roller shall overlap the adjacent rolled area by at least 2 feet. If the moisture content is greater or less than that required for compaction, the rolling or tamping shall be delayed until the proper moisture content as determined by the ontracting officer has been reached.

(f) Equipment for Compaction by Rolling. Equipment consisting of an oscillating double section sheepsfoot tamper roller, pulled by a crawler type tractor weighing not less than 20,000 pounds and which is weighted, or equipped with a bulldozer or both, to increase its total weight to not less than 29,000 pounds, shall be used for compacting Class I and Class II fill. The use of more than 2 rollers in tandem will not be permitted. The design and operation of the compacting equipment shall be subject to the approval of the contracting officer. The speed of the compacting equipment shall be not more than 2½ miles per hour. Each drum of the oscillating double section sheepsfoot tamper roller shall be approximately 4 feet in width and shall have tamping feet uniformly staggered over its cylindrical surface and be provided with cleaners. Each tamping foot shall project approximately 7 inches from the roller's cylindrical surface and at no time during operation shall have a face area less than 5 nor more than 7 square inches. The spacing shall be such as to provide not less than 1½ tamping feet for each square foot of cylindircal surface. The sheepsfoot roller shall be weighted so that the total weight of the roller and ballast in pounds divided by the total areas of the maximum number of tamping feet in one row generally parallel to the axis of the roller shall provide for a range of 250 to 400 pounds per square inch by varying the roller ballast.

(g) Tests for Compaction. - Samples for testing of all materials in the embankments, both before and after placement and compaction, will be taken by the contracting officer at frequent intervals. Corrections, adjustments, and modifications of methods may be required as the result of these tests, for materials, moisture content, or additional compaction of the materials in the embankment. In taking samples for control and record purposes, the contractor shall supply labor required to assist the inspector, as directed by the contracting officer. During the construction of the embankments, it may be necessary for the contractor as directed by the contracting officer to construct test embankments which will form part of the completed fill to determine the number of passes or moisture content necessary to obtain the desired compaction.

(h) Additional Compaction. - If the tests specified above indicate that the desired compaction of the materials in the compacted earth fill sections of the embankments is not secured by the compaction specified in paragraph 4-04 (e), additional compaction may be required by the contracting officer. Additional compaction shall consist of making not less than 2 passes of a sheepsfoot roller specified in paragraph 4-04 (f) over such designated areas. Each pass of a roller shall overlap the adjacent rolled area by at least 2 feet. This procedure will be repeated as often as is necessary to obtain the desired compaction.

(i) Measurement and Payment.

(1) Measurement of Class I and Class II compacted earth fill placed in embankments will be made between the lines indicated on the drawings and the required stripping or excavation lines. Payment for Class I and Class I compacted earth fill will be made at the contract unit price per cubic yard for "Earth Fill, Compacted, Class I and Class II", which payment shall include all incidental work specified or requires such as transporting and spreading, mixing, scarifying, harrowing, moistening, drying, compacting, removing oversize stones and objectionable materials.

(2) Payment for each additional two passes of a roller as required by the contracting officer will be made at the contract unit price per square (100 sq. ft.) for "Additional Compaction".

## 4-05. CLASS III FILL.

(a) General. - Material for Class III fill shall be secured from the required excavations for the canal and concrete structures. The material, except in the upper 3 feet on the pool side, shall be any material as approved by the contracting officer in excess of that required or not satisfactory for Class I and Class II compacted fill. It may contain boulders, stones, sod, and strippings, providing they are embedded, satisfactory to the contracting officer. The material in the upper 3 feet on the pool side shall be well graded, clayey or silty gravelly sand and shall be free from sod, stripping, roots and other perishable or bouyant materials. Class III fill may be placed in layers of a thickness not to exceed 5 feet. The layers shall extend at approximately uniform elevation over the entire length and width of the fill. At no time during placing shall the top of the Class III fill be above, nor more than 6 feet below, surface of the adjoining Class II fill.

(b) Measurement and Payment. - Measurement for Class III fill placed in the embankments shall be made between the slope lines indicated on the drawings and the original surface. Payment for Class III fill placed in the embankments will be made at the contract unit price per cubic yard for "Class III fill", which payment shall include all incidental work specified or required such as transporting, spreading and maintaining the surface for satisfactory operations.

## 4-06. FILTER

(a) General. - Filters shall be constructed at the locations and to the lines and grades shown on the drawings, or at such other locations as may be required by the contracting officer, and shall be placed and compacted the same as for Class II compacted fill. The material shall conform to the requirements specified in the following paragraph and, if practicable during construction, shall be kept to the same height as the adjacent fill material.

(b) Filter Material. - The material for filters shall be well graded sand, or sand and gravel, which after placement, shall contain at least

40 percent by weight which will pass the 1/4-inch mesh screen and no stones shall be larger than 6 inches. Of the material passing the 1/4-inch screen, at least 80 percent by weight shall pass a No. 10 mesh screen, and not more than 10 percent shall pass the No. 200 mesh screen. Samples of the material the contractor proposes to use shall be submitted to the contracting officer at least 30 days prior to the date that the contractor plans to commence placement of filter.

(c) Measurement and Payment. - Measurement of filter material will be made between the lines indicated on the drawings, or as modified by the contracting officer. Payment for furnishing and placing filter material, regardless of source (see paragraph 1-16) will be made at the contract unit price per cubic yard for "Filter".

### 4-07. SAND AND GRAVEL BACKING.

(a) General. - Sand and gravel backing for riprap on slopes shall be constructed to the lines and grades shown on the drawings. During construction the placing shall be kept at substantially the same level as the compacted earth fill.

(b) Material. - Material for sand and gravel backing shall consist of bank run sand and gravel of which the material after placement shall contain from 30 to 60 percent by weight retained on the 1/4-inch mesh screen, and no stones shall be larger than 6 inches. Of the material passing the 1/4-inch mesh screen, not more than 20 percent shall pass No. 200 mesh screen. Samples of proposed material shall be submitted (see paragraph 4-06 (b)).

(c) Measurement and Payment. - Measurement of sand and gravel backing material will be made between the lines indicated on the drawings, or as modified by the contracting officer. Payment for furnishing and installing backing material, regardless of source, (see paragraph 1-16) will be made at the contract unit price per cubic yard for "Sand and Gravel Backing."

### 4-08. RIPRAP.

(a) Classification. - All rock for the riprap protection of the embankments shall be clean, sound, and durable, and as approved by the contracting officer. Shale and other rock which in the opinion of the contracting officer will not endure frost action shall not be used. Riprap shall be composed of the following two classes of material:

(1) Class A. - Eighty percent of the Class A riprap shall be pieces weighing over 500 pounds and the remainder shall vary with fair uniformity to a minimum weight of 200 pounds. The least dimension of any stone shall be not less than one-third its greatest dimension.

(2) Class B. - This riprap shall consist of rocks weighing in general not over 250 pounds, of which not more than 10 percent of the whole shall be formed of pieces weighing less than 15 pounds which shall be well distributed throughout the mass.

(b) Placement. - Riprap shall be dumped in the sections to the line and grades shown on the drawings or as directed by the contracting officer. The different sizes of each class shall be well distributed within the section. Care shall be taken in dumping and placing not to disturb the underlying fill. The riprap forming the downstream toe of the wing dams shall be placed in approximately horizontal layers not exceeding 3 feet in thickness as the compacted earth fill progresses, and shall be kept at substantially the same level as the compacted earth fill. The dumped riprap on the upstream slope of the wing dams may be placed at any time during the construction of the embankments providing that the level of the riprap shall not exceed the level of the compacted earth fill section; any change in the slopes of the compacted earth fill including slides and washout shall be repaired by the contractor as directed by the contracting officer at no cost to the Government. Placing of riprap for canal bank protection shall be completed before the canal banks are exposed to erosion. In the areas where Class B dumped riprap will form the final surface, such hand placing of the finished rock surface will be required as will insure reasonably smooth and continuous surface to the slope lines shown on the drawings or as modified by the contracting officer with a tolerance not exceeding plus or minus 9 inches. At the end of a working season for placing compacted earth fill, the dumped riprap sections shall be complete.

(c) Measurement and Payment. - Measurement for riprap in the dumped riprap sections will be made in the embankments between slope lines and grade lines shown on the drawings or as modified by the contracting officer. Payment for the two classes of riprap will be made at the contract unit prices per cubic yard for "Riprap, Dumped; Class A", and "Riprap, Dumped; Class B", which shall include payment for furnishing, (see paragraph 1-16) cleaning, hauling, placing, and all other work required for the completion of the riprap sections in accordance with these specifications.

## 4-09. ROLLED GRAVEL SURFACE.

(a) General. - The surface of the roadway along the top of both wing dams shall consist of a 12-inch layer of well-graded run-of-bank gravel which, after placement, shall meet the following requirements; not more than 50% or less than 25% by dry weight shall be retained on a ¼-inch screen. Of the material passing the ¼-inch screen, not more than 20% by dry weight shall pass the No. 200 sieve. The method of placement shall be according to the specifications of the State of New York, Division of Highways, Item 39-Foundation Course-Run-of-Bank Gravel.

(b) Measurement and Payment. - The quantity to be paid for shall be the number of square yards of compacted material in place as shown on the plans or as ordered by the contracting officer. The price bid shall cover the furnishing, placing, filling, and rolling of the material and all labor and incidental expenses necessary to complete the work. Payment will be made at the contract unit price per square yard for "Rolled Gravel Surface," as indicated in the Schedule of Bid Items.

## 4-10. SEEDING

(a) Preparation of Seed Bed.

(1) The areas indicated on the drawings or required by the contracting officer shall be seeded. All areas to be seeded shall, prior to fertilizing and seeding, be harrowed or raked until the soil has become loosened and pulverized. All sticks, litter, roots, weeds, stones larger than 1 inch in diameter, and other objectionable materials shall be removed to a depth of 2 inches. The surface of all areas to be seeded shall be trimmed and raked to conform to finished grades, after which the soil shall be fertilized as specified below. Immediately before sowing the seed, the surface of the seed bed shall be sprinkled, if necessary, and raked to a depth of 3/4 of an inch. The raking shall be done in a direction parallel to the contour lines of the slopes (not uphill or downhill).

(2) Method of Fertilizing. - Prior to seeding, fertilizers shall be uniformly spread in a manner satifactory to the contracting officer. The seed beds consisting of topsoil shall be fertilized with 1,000 pounds of 20% superphosphate, and 200 pounds of sulphate of ammonia to the acre. In place of the superphosphate, 330 pounds of T.V.A. metaphosphate to the acre may be used.

(b) Seeding. - The quantity and types of seeds specified below shall be sown on prepared seed beds in a manner satisfactory to the contracting officer. The mixtures shall be sown at the earliest date possible between May 1 and September 1. The seed mixtures shall be sown by a mechanical hand seeder or drill. Whenever practical, the mixtures shall be sown in two applications, one-half the seed while the sower is travelling in one direction, and the other half sown while travelling and at right angles to the first. The oats or rye shall be sown separately and prior to the remainder of the seed mixture. If oats or rye are sown on the surface, the seeds shall be covered by raking to a depth from 1 to 1½ inches, unless the oats or rye are sown with a drill. After all the seed is sown, the seed bed shall be lightly raked with iron rakes, and then rolled with a lawn roller in a manner satisfactory to the contracting officer.

(1) **Seed Mixtures.** - The seed mixtures shall consist of the seeds specified in the table below. When directed by the contracting officer, the seed mixtures may be varied to suit special conditions of soil peculiar to the areas to be seeded. The seed furnished shall be of the previous year's crop and in no case shall the weed content exceed 1% by weight.

| | Seed Mixture | | Amount lbs. |
|---|---|---|---|
| Kind of Seed | % Purity | % Germination | per acre |
| Sweet Clover | 99 | 85 | 5 |
| Alfalfa | 98 | 85 | 2 |
| Black Medic | 95 | 80 | 1 |
| Orchard Grass | 97 | 90 | 3 |
| Timothy | 98 | 85 | 3 |
| Red Top | 98 | 90 | 4 |
| Ladino Clover | 97 | 90 | 1 |
| | | | 19 |
| Oats (Seeding prior to July 15) | 99 | 90 | 30 |
| Rye (Seeding after July 15) | 99 | 90 | 35 |

(2) Inoculation. - The Alfalfa, Black Medic, Sweet Clover, and Ladino Clover seeds shall be inoculated with pure cultures of nitrogen fixing bacteria. Inoculants shall consist of pure bred.soil or sand cultures not more than one year old, and shall meet the approval of the New York State Department of Agriculture and Markets. The inoculants shall be mixed with the seed according to the vender's instructions. After the mixture is dried, it shall be mixed with the grass seeds. All mixing,drying and storing shall be done in the shade. The seed mixture shall be applied to the seed bed within 72 hours after the legume seeds are inoculated.

(c) Maintenance and Reseeding. - The contractor shall maintain the areas sown with the above seed mixtures until all work on the contract has been completed and accepted by the contracting officer. The maintenance shall consist of refilling rain-washed gullies, reseeding, mowing, watering during periods of drought, and other similar operations when required by the contracting officer. The contractor may, if he desires, protect slopes against erosion until seeding becomes established by spreading on the surface about four tons of straw to the acre.

(d) Measurement and Payment. - Measurement for seeding will be made by the acre for the area within the line shown on the drawings or as modified by the contracting officer. The contract unit prices shall include payment for all work in connection with furnishing and sowing all necessary seed, raking and rolling the seeded areas, preparing the seed beds, furnishing and placing all necessary fertilizer, and maintaining all seeded areas. Payment for seeding all seed beds will be made at the contract unit price per acre for "Seeding."

## SECTION V - CONCRETE

5-01. COMPOSITION. - Concrete shall be composed of cement, fine aggregate, coarse aggregate and water so proportioned and mixed as to produce a durable, plastic, workable mixture in accordance with all requirements under this section and suitable to the specific conditions of placement.

5-02. CLASSIFICATION.

(a) Designation. - Except where required to meet special conditions, all concrete shall be Class "A" or Class "B", in accordance with the conditions of application and the proportions of materials and strengths required.

(b) Class "A" concrete shall be used generally in thin walls, slabs, and beams, for embedding metal in pre-formed recesses, and at such other places as shown on the drawings or as directed by the contracting officer.

(c) Class "B" concrete shall be used in all other parts of the intake structure not specifically designated as Class "A" concrete.

5-03. STRENGTH.

Test specimens of concrete will be 6"x12" or 8"x16" cylinders. Samples will be wet-screened to remove aggregate greater than one-fourth the diameter of the test specimen. The mixes will be designed to secure concrete having at least the following compressive strengths at the age of 28 days:

| Class | Average for any 25 Consecutive cylinders | Minimum for any one cylinder |
|---|---|---|
| A | 3400 lbs. per sq. in. | 2600 lbs. per sq. in. |
| B | 3000 lbs. per sq. in. | 2200 lbs. per sq. in. |

5-04. HIGH-EARLY-STRENGTH CONCRETE. - High-early-strength concrete made high-early-strength Portland cement or other special cements shall be used only when specifically authorized by the contracting officer. The 7-day compressive strength of concrete of any class, when made with high-early-strength cement, will be at least equal to the specified minimum 28-day compressive strength for that class using standard cement. All provisions of these specifications, except for cement and aggregates, shall be applicable to such concrete.

5-05. CEMENT AND AGGREGATES. - Cement, and fine and coarse aggregates will be furnished to the contractor by the Government in accordance with paragraph 1-10 of these specifications.

5-06. WATER. - The water used in mixing concrete shall be clean and free from injurious amounts of oil, acid, alkali or organic matter.

5-07. STORAGE.

(a) Cement.

Immediately upon receipt, at the site of the work, cement shall be stored in a thoroughly dry, weathertight, and properly ventilated building or bin with adequate provisions for the prevention of the absorption of moisture. Storage shall be such as to permit easy access for inspection and definite identification of each shipment.

(b) Aggregates. - Each size of aggregate (see paragraph 5-08(f)) shall be stored separately and in such manner as to avoid the inclusion of any foreign material. The aggregates shall be stored in free draining stock piles or bins for at least 72 hours prior to use. Stock piles of coarse aggregates shall be built in horizontal layers to avoid segregation.

5-08. PROPORTIONING.

(a) Basis. - All concrete materials will be proportioned so as to produce a workable mixture in which the water content will not exceed the maximum specified.

(b) Control. - The exact proportions of all materials entering into the concrete shall be as directed by the contracting officer. The contractor shall provide all equipment necessary to determine, record, and control positively the actual amounts of the various materials, including water, cement, fine aggregate, and each individual size of coarse aggregate, entering into the concrete. The proportions will be changed whenever, in the opinion of the contracting officer, such change becomes necessary to obtain uniformity and workability or the specified strength, and the contractor will not be compensated because of such changes.

(c) Measurement. - All materials shall be measured by weight. One bag of cement will be considered 94 pounds in weight and 1 gallon of water as 8.33 pounds.

(d) Cement Content. - The cement content for each cubic yard of concrete shall generally fall within the following ranges:

Class "A" 5.0 to 6.0 bags

Class "B" 4.0 to 5.0 bags

For concrete deposited in water, the minimum cement content shall be 6.5 bags or 611 pounds to each cubic yard of concrete placed. The cement content shall be at all times subject to variation as deemed necessary by the contracting officer to attain the desired results.

(e) Water Content and Consistency of Concrete.

(1) In calculating the total water content in any mix, the

amount of moisture carried on the surfaces of the aggregate particles shall be included. The total water content per bag of cement for each batch of concrete shall not exceed the following:

Class "A" 5.5 gallons or 45.8 pounds

Class "B" 6.5 gallons or 54.1 pounds.

In all cases, however, the amount of water to be used shall be the minimum amount necessary to produce a plastic mixture of the strength specified and of the desired density, uniformity and workability. In general, the consistency of any mix shall be that required for the specific placing conditions and methods of placement, and ordinarily the slump shall be between 1/2 inch and 2 inches for Class "B" concrete, and between 1½ inches and 3 inches for Class "A" concrete when tested in accordance with the current specifications for "Method of Test for Consistency of Portland Cement Concrete," of the American Society for Testing Materials.

(f) Aggregate Content. - The total volume of aggregates to be used in each cubic yard of concrete shall be that necessary to produce a dense mixture of the required workability as determined by the contracting officer. The individual mixes will be based upon securing concrete having suitable workability, density, impermeability, and the required strength, without the use of an excessive amount of cement.

(1) Coarse Aggregate.

For Class "A" concrete the maximum size aggregate shall be not more than 1½ inches.

For Class "B" concrete the maximum size aggregate shall be not more than 3 inches.

(1) Specified sizes shall be delivered separately to individual proportioning hoppers in accordance with the following:

a. 3/16" to 3/4"

b. 3/4" to 1½"

c. 1½" to 3"

(2) Fine Aggregate. - The fine aggregate will consist of natural sand or crushed stone sand and in either case will be furnished in one size graded so that at least ninety-five percent will pass a No. 4 square mesh sieve.

5-09. MIXING AND PLACING

(a) Equipment. - The contractor shall provide at the site of the work a modern and dependable batch-type mixing plant with a minimum capacity of 800 cubic yards of concrete per 8 hours. The plant shall include not fewer than 2 complete mixers of equal capacity with separate power plants. The equipment shall provide adequate facilities for the accurate measurement, record, and control of each of the materials entering the concrete. The complete plant assembly, including provision to facilitate the inspection of operations at all times and the adequacy and dependability of each of its parts, shall be subject to the approval of the contracting officer, and shall conform to the following requirements.

It shall be capable of ready adjustment for compensating for the varying moisture content of the aggregates and for changing the proportionate batch weights.

It shall be capable of controlling the delivery of each material to within 1 percent by weight of the designated amounts.

It shall be arranged to permit the convenient removal of material in excess of the specified tolerances, and acceptable facilities shall be provided for readily obtaining representative samples from the batches for test purposes.

Each weighing unit shall include a visible springless gage which will register the scale load at any stage of the weighing operation from zero to full capacity.

Insofar as practicable, each dial and water-measuring device shall be in full view of the operator and the weighing equipment shall be arranged so that the operator may conveniently observe the operation of the bin gates and also the materials discharged into the mixer hopper.

The accuracy of the weighing equipment shall conform to the requirements of the U. S. Bureau of Standards. The contractor shall provide standard test weights and any other auxiliary equipment required for checking the operating performance of each scale or other measuring device and shall make periodic tests, in the presence of a Government inspector, in such a manner and at such intervals as may be directed by the contracting officer; provided, that unless otherwise directed by the contracting officer, such check rests of equipment in operation shall be made at least once every two weeks. After completion of such check tests the contractor shall make such adjustments, repairs, or replacements as the contracting officer may consider necessary to secure satisfactory performance.

The plant shall include a device for accurately measuring and indicating the quantity of water entering the concrete and the operating mechanisms must be such that leakage will not occur when the valves are closed. The filling and discharge valves for the water tank shall be so interlocked that the discharge valve cannot be opened before the filling valve is fully closed.

It shall include a device for accurately and automatically measuring and indicating the time of mixing, which shall be interlocked to prevent the discharge of concrete from the mixer before the expiration of the mixing period.

It shall include a device for recording and indicating the number of batches handled.

Each set of units for measuring cement and mixing water delivered to one or more mixers shall be provided with an accurate combined autographic recorder for making a continuous visible record on a single chart of measurement of all materials introduced into each batch, and of the consistency of the concrete during the mixing process. The recorder shall be housed completely, shall be capable of being locked, and shall be placed in a position convenient for use by the plant operator. The recorder paper furnished shall be ruled and printed so that each graph will be identified permanently and so that quantities and time may be read without scaling or calculation. Suitable means shall be provided to insure proper alignment, rate of travel, and tautness of the paper without wrinkling. The recording equipment shall include facilities for automatically registering on the chart for time of day at intervals of not more than 15 minutes and shall be designed for simplicity in operation and maintenance.

Each mixer shall be equipped with an efficient recording consistency meter or provided with equally suitable equipment or means satisfactory to the contracting officer for indicating concrete consistency and recording it on the combined autographic recorder chart. The sensitivity and range of the consistency meters shall be such that the effect of a change in slump of one inch shall be readily discernible to the operator, as determined by the contracting officer. The contractor shall furnish satisfactory evidence that the consistency meters which he proposes to use are adapted to the type of drum and loading of the mixers with which they are to be used. If the mixers are provided with consistency meters operating on the principle of measuring electrical input to the mixer motors, adequate means shall be provided for eliminating errors due to operating the motor from a variable-voltage supply source, with resultant changes in motor input which are not caused by changes in concrete consistency. If the contractor proposed to use means for the partial elimination and compensation of these errors, such means shall be subject to the approval of the contracting officer and the residual errors shall not exceed one percent of the values being measured. Errors in registration of concrete consistency caused by variable friction in the mixer equipment shall be eliminated or minimized by providing adequate antifriction bearings and lubrication or by other means satisfactory to the contracting officer. All graphic charts recorded in accordance with this paragraph shall become the property of the Government.

(b) Mixing Time. - The minimum time for mixing each batch, after all materials are in the mixer, shall be as follows:

| | |
|---|---|
| 1/2-cubic yard mixer, or smaller | 1-1/4 minutes |
| 3/4 - to 1½ cubic yard mixer | 1½ minutes |
| 1½- to 3-cubic yard mixer | 2 minutes |
| larger than 3-cubic yard | 2½ minutes |

The mixer shall revolve at a uniform speed, a minimum of 12 revolutions per minute after all materials have been placed in it. Neither speed nor volume capacity of the mixer shall exceed those recommended by the manufacturer. Excessive overmixing, requiring additions of water to preserve the required consistency, will not be permitted. Should any mixer at any time produce unsatisfactory results its use shall be promptly discontinued until it is repaired or replaced.

(c) Conveying. - Concrete shall be conveyed from mixer to forms as rapidly as practicable, by methods which will prevent segregation or loss of ingredients. It shall be deposited as nearly as practicable in its final position. Chutes used shall be such that the concrete slides in them and does not flow. Chutes with a flatter slope than 1 or 2 will not be permitted. There shall be no free vertical drop greater than 5 feet except where specifically authorized by the contracting officer.

Methods of conveying concrete to any part of the structure by which the concrete is loaded into chutes, belt conveyors, or other similar equipment and carried in a thin, continuously exposed flow, to the forms, will not be permitted except for very limited or isolated sections of the work, and then only when approved in writing by the contracting officer.

Placing of concrete shall, in general, be done by means of bottom-dump buckets of sufficient size to handle the full capacity of one mixer. The design of the buckets shall be subject to the approval of the contracting officer, and shall be such as to permit close regulation of the amount of concrete to be deposited in each dumping position. It is contemplated that the full capacity of a bucket may be deposited in one operation where this has no objectionable effect on the placement of concrete, but near forms and around embedded items or elsewhere as directed by the contracting officer, the discharge shall be controlled so that the concrete may be effectively compacted into layers not exceeding 18 inches in thickness with a minimum of lateral movement and accompanying tendency for segregation and the formation of rock pockets.

(d) Placing.

(1) Concrete shall be placed before initial set has occurred, and, unless otherwise authorized by the contracting officer, before it has contained its water content for more than 30 minutes.

(2) Concrete when deposited in the forms shall have a temperature of not less than 40 degrees F. and not more than 75 degrees F. However, when the temperatures of the materials are such that the temperature of the fresh mixed concrete is 55 degrees or more, the mixing water shall be cooled to a temperature of 35 degrees F., and only aggregates taken from the coolest portions of the stockpiles shall be used. Any heating, cooling, refrigerating, or other operations necessary in order to produce a concrete having a temperature within the above specified temperature limits (40° F. to 75° F.), shall be done by the contractor and the cost thereof shall be included in the unit contract prices for the various classes of concrete.

(3) Unless otherwise specified, all concrete shall be placed in the dry upon clean, unfrozen, damp surfaces, free from running water, and never upon soft mud, dry porous earth, or upon fills that have not been subjected to approved rolling or tamping until optimum compacting has been obtained.

(4) Rock surfaces upon which concrete is to be placed shall be approximately horizontal or stepped, and shall be clean, solid, and free from oil, running water, mud, objectionable coatings, debris and loose, semi-detached, or unsound fragments and shall be sufficiently rough to assure satisfactory bond with the concrete. Immediately before concrete is placed, all such rock

surfaces shall be cleaned thoroughly by the use of high velocity air-water jets, wet sandblasting, stiff brooms, picks, or other effective means satisfactory to the contracting officer. All pools of water shall be removed from depressions in order to insure proper bonding of the fresh concrete to the rock surfaces and no inflow of water into the foundation will be permitted. All necessary installations of riser pipes, headers, sand drains, and other installations necessary to produce a foundation free of running or standing water shall be installed by the contractor and so welded or otherwise securely fastened in place as to prevent their being jarred loose by concrete placement. No separate payment will be made for such installations. No wooden plugs or other organic materials will be placed permanently in any foundation. All absorptive surfaces shall be thoroughly wetted for 48 hours and spread with a layer of mortar about 1/2 inch thick immediately before the concrete is placed. The mortar shall be of the same cement-sand ration as used in the concrete.

(5) The layout of all monoliths shall be as shown on the drawings or as directed or approved by the contracting officer before concreting is commenced.

(6) All concrete shall be deposited in approximately horizontal layers, unless otherwise specifically authorized or directed by the contracting officer, and the concreting shall be carried on as a continuous operation, as far as practicable, until the placing in the course, section, panel or monolith is completed. Concrete must be covered within 45 minutes to one hour, depending on cement used, with fresh concrete during one pour. Lifts of mass concrete shall not exceed 5 feet in thickness except as shown on the drawings or as approved by the contracting officer. In general a minimum of 24 hours shall elapse for each foot of thickness between the finishing of one such lift and the starting of the next. The first two to four lifts starting from the rock foundation and from lifts which have been in place longer than 15 days shall be limited to a maximum height of 2 to 3 feet; as determined by the contracting officer. Other lifts shall generally have a minimum thickness of 4 feet, and maximum thickness of 12 feet.

(7) In dropping concrete through reinforcement, care shall be taken that no segregation of the coarse aggregate occurs. On flat surfaces where the congestion of steel near the forms makes placing difficult, a mortar of the same cement-sand ratio as is used in the concrete shall be first deposited to cover the forms.

(8) All top surfaces not covered by forms and which are not to be covered by additional concrete or backfill shall be carried slightly above grade and struck off by board screed (see paragraph 5-11(a).

(e) Vibrating. - Concrete shall be placed with the aid of mechanical vibrating equipment as approved by the contracting officer.

(1) Internal vibrators shall be used in all sections 10-inches or more in width or which are sufficiently large to accommodate them. External vibration shall be used when directed by the contracting officer as auxiliary to internal vibration.

(2) Vibrators shall be of sturdy construction, adequately powered

and capable of transmitting to the concrete not less than 5,000 impulses per minute when operating under load (immersed in concrete). The frequency of vibration shall be subject to proof by measuring the impulses radiated by the vibrator, when operating in concrete designed for the project, by use of a Frahm vibrating-reed tachometer or equal. The vibration shall be sufficiently intense to cause the concrete to flow or settle readily into place and show a visible effect over a radius of at least 18 inches in the concrete.

(3) A sufficient number of vibrators shall be employed so that, at the required rate of placement, vibration throughout the entire volume of each layer of concrete and complete compaction are secured. At least one extra vibrator shall be constantly on hand at each point of placement (monolith) for emergency use.

(4) Form vibrators, where used, shall be attached to or held on the forms in such a manner as to transmit the vibration to the concrete effectively and shall be raised in lifts as filling of the forms proceeds, each lift being not more than the height of concrete visibly affected by the vibration. They shall be placed horizontally at distances not greater apart than the radius through which the concrete is visibly affected.

(5) Internal vibrators shall be kept constantly moving in the concrete and shall be applied at points uniformly spaced not farther apart than the radius over which the vibrator is visibly effective. The vibrator shall not be held in one location long enough to draw a pool of grout from the surrounding concrete. Internal vibrators shall be applied close enough to the forms to vibrate the surface concrete effectively but care shall be taken to avoid hitting the forms sufficiently to damage them.

(6) The vibration shall be such that the concrete becomes uniformly plastic and there shall be at least 10 seconds of vibration per square foot of surface of each layer of concrete, computed on the basis of the visibly affected radius, and taking over-lapping into consideration.

(7) Vibration shall be supplemented by forking and spading by hand adjacent to the forms on exposed faces. The concrete shall be compacted and worked in an approved manner into all corners and angles of the forms and around reinforcement and embedded fixtures.

(f) Construction Joints. - Vertical joints shall be formed at such locations and of such shapes and dimensions as approved or directed by the contracting officer. Horizontal joints shall be continuous throughout all monoliths to produce continuous horizontal lines on the faces of the lock walls. The horizontal edges of each completed pour not required to be chamfered that are exposed to weathering shall be struck off level for a distance of about 6 inches back from the form to provide an even and neat appearance between construction joints. Where required, dowel rods shall be used.

All concrete in vertical members shall have been in place not less than 12 hours, and longer if so directed by the contracting officer, before concrete in horizontal members resting thereon is placed.

After the top surface of a course is finally compacted, it shall be thoroughly protected from pedestrian traffic, materials being placed thereon, running water, or any activity upon the surface that might in any manner affect the initial setting of the concrete for a period of 4 to 20 hours as determined by the contracting officer. After the time required for initial set, the surface shall be washed with a high pressure air (air pressure capacity not less than 100 p.s.i.) and water jet to remove all laitance and to expose clean sound aggregate.

Immediately before placing is resumed in each succeeding course, all approximately horizontal construction joint surfaces shall be washed with a high pressure air and water jet and scrubbed with steel brushes and brooms. Sand shall be added to the air-water jet when required to remove algae, stains and other substances injurious to bonding. After final cleaning and immediately before placing is resumed the surface shall be wetted and spread with a layer of mortar 1/2 inch thick. The mortar shall be of the same cement-sand ratio as the concrete.

Where fresh concrete is to be placed against smooth surfaces of previously placed concrete, the surface of the previously placed concrete shall be roughened by picking, or other means approved by the contracting officer, in order to secure adequate bond. No payment will be made for such roughening but the cost shall be included in the contract unit price for the class of concrete affected.

(g) In water. - When specifically authorized, concrete may be deposited in water having a temperature above 35 degrees F. The methods and equipment used shall be subject to the approval of the contracting officer. When deposited by the tremie method, the tremie shall be water-tight and sufficiently large to permit a free flow of concrete. The discharge shall be kept continuously submerged in the concrete and the shaft kept full of concrete to a point well above the water surface. When the bottom-dump bucket method is used, the bucket shall not be dumped until after it has come to rest on the surface upon which the concrete is to be deposited. The bucket shall be provided with a suitable cover, and the bottom doors, when tripped, shall open freely. The bucket shall be completely filled and slowly lowered in order to avoid backwash, and when tripped, it shall be slowly withdrawn until entirely free of the concrete. With either method, concreting shall proceed without interruption until the top of the concrete is well above the water surface.

(h) Cold Weather. - Concrete shall not be placed when the ambient atmospheric temperature is below 35 degrees F. nor when the concrete is likely to be subjected to freezing temperatures before final set has occurred, unless specifically authorized by the contracting officer in writing. When so authorized, the materials shall be heated in such a manner that they will be free of ice, slush, snow, frozen lumps, etc., before entering the mixer. The temperature of the concrete when deposited in the forms shall be within the limits specified in paragraph 5-09(d)(2). All methods and equipment for heating shall be subject to the approval of the contracting officer.

(i) Hot Weather. - For concrete placed during the extremely warm summer months and otherwise, when directed by the contracting officer, the contractor shall take whatever measures are necessary in order to produce a concrete having a temperature below the maximum limit specified in paragraph 5-09(d)(2). The methods and equipment used shall be subject to the approval of the contracting officer.

## 5-10. TEST SPECIMENS.

(a) Number. - Test specimens, to determine whether the compressive strength of the concrete is in accordance with that specified in paragraph 5-03, will be taken by the Government inspector. At least 1 set of 3 specimens will be made for every major placement and, in general, for every 500 cubic yards of concrete placed, but in any event, a sufficient number of specimens will be taken to give a comprehensive knowledge of the concrete in each section of the work.

(b) Method. - All specimens will be taken from the concrete in accordance with the current specifications of the American Society for Testing Materials. The specimens will be tested by and at the expense of the United States, either in its laboratory or in that of a recognized commercial testing agency.

## 5-11. FINISHING.

(a) General. - Immediately after placement, the concrete shall be properly forked back along the faces of all forms by the use of concrete forks or spades and then re-vibrated unless otherwise specifically authorized or directed by the contracting officer. The surface of concrete finished against forms shall be smooth, dense, and free from rock pockets. Immediately upon the removal of forms, all unsightly ridges or lips shall be removed and undesirable local bulging on exposed surfaces shall be remedied by tooling and rubbing to the satisfaction of the contracting officer, all holes left by the removal of tie rods, and all similar voids unless otherwise directed by the contracting officer shall be neatly filled with cement mortar mixed in the same proportions as the original mix, provided that wherever practicable mortar which has been mixed and allowed to stand for one hour shall be used and placed as directed by the contracting officer. Defective concrete shall be repaired by cutting out the unsatisfactory material and placing new concrete which shall be formed with keys, dovetails, or anchors to attach it securely to the other work. This concrete shall be drier than the usual mixture and shall be thoroughly tamped into place. All finishing, tooling, rubbing and filling of the rod holes and all patching of exposed surfaces must be performed immediately after forms are removed and the succeeding course of concrete shall not be placed until the exposed surfaces of the preceding lifts have been finished to the satisfaction of the contracting officer. All surfaces of concrete, not covered by forms, that are not to be covered by additional concrete or backfill, shall have a wood float finish without additional mortar, and shall be true to elevations as shown on the drawings. Care shall be taken to see that all excess water is removed before making this finish. Other surfaces shall be brought to the specified finished elevation and left true and regular as approved by the contracting officer. Where considered necessary by the contracting officer, or where indicated on the drawings, joints shall be carefully made with a jointing tool. Every precaution shall be taken by the contractor to protect finished surfaces from stains or abrasions. No fire shall be permitted in direct contact with any concrete at any time. Concrete surfaces, or edges likely to be injured during the construction period, shall be properly protected by leaving the forms in place or by erecting covers satisfactory to the contracting officer.

(b) Floor Surfaces. - Unless otherwise specified, floors and other surfaces where indicated on the plans or required by the contracting officer, shall be finished with a 1-inch monolithic sand-cement mortar surface. All water, laitance and any foreign matter shall be removed from the surfaces. The topping mixture shall be spread evenly over the base within 45 minutes after the base has been placed. The mortar shall be of 1 part cement and 3 parts approved clean sand. The cement and sand shall be thoroughly mixed dry and then sufficient water shall be added to produce a medium stiff mortar. After placing, the mortar shall be floated to a true, regular surface with a wood float and steel-trowled to a smooth finish. Troweling shall be the minimum amount consistent with obtaining a smooth dense surface and shall not be done until the mortar has hardened sufficiently to prevent excess fine material from being worked to the surface.

### 5-12. CURING.

(a) General. Before actual concrete placement begins, the contractor shall have on hand and ready to install all equipment needed for adequate curing and protection of the concrete.

(b) Warm Weather. - All concrete shall be adequately protected from injurious action by the sun. Fresh concrete shall be protected from heavy rains, flowing water, and mechanical injury. All concrete shall be kept wet for a period of not less than 14 days by covering with water, or with an approved water-saturated covering or by a system of perforated pipes or mechanical sprinklers, or any other approved method which will keep all surfaces continuously (not periodically) wet. Where wood forms are left in place for curing, they shall be kept wet at all times to prevent opening at the joints and drying out of the concrete. Water for curing shall conform to the requirements of paragraph 5-06, and shall be generally clean and entirely free from any elements which, in the opinion of the contracting officer, might cause staining or discoloration of the concrete.

(c) Cold Weather. - Concrete when placed during cold weather shall be kept moist and provided with adequate protection, subject to the approval of the contracting officer, so that the air in contact with the concrete will be maintained at temperatures between 50 degrees F. and 70 degrees F. for at least the first 5 days. For massive section, where the atmospheric temperatures are sufficiently low, in the opinion of the contracting officer, to cause excessively rapid cooling and contracting of the exterior surfaces, the period for maintaining the temperature of the air in contact with the concrete between 50 and 70 degrees F. may be required to extend for 14 days. In extremely cold weather, the removal of temperature protection shall be done gradually so that the temperature of the air surrounding the concrete is reduced to the outside air temperature at a rate not faster than 5 degrees F. in any one hour, or 50 degrees F. in any 24 hour period. Salt or other chemicals shall not be admitted into the mixture to prevent freezing.

### 5-13. FORMS.

(a) Materials. - Forms shall be of wood, steel or other approved material, except that the sheeting for all exposed surfaces shall be tongue-and-groove lumber of uniform width unless otherwise specifically authorized. Forms of like character shall be used for similarly exposed surfaces in order to produce a uniform appearance. The type, size, shape, quality and strength of all materials of which the forms are made and the design of the forms shall be subject to the approval of the contracting officer.

(b) Construction. - Forms shall be built true to line and grade, and shall be mortar-tight and sufficiently rigid to prevent displacement or sagging between supports. Where forms for continuous surfaces are placed in successive units, care shall be taken to fit the forms tightly over the completed surface so as to prevent leakage of mortar from the concrete and to maintain accurate alignment of the surface. Responsibility for their adequacy shall rest with the contractor. Their surfaces shall be smooth and free from irregularities, dents, sags, or holes when used **for permanently exposed faces.** Bolts and rods used for internal ties shall be so arranged, that, when the forms are removed all metal will be not less than 2 inches from any concrete surface. Bolt holes shall be reamed with a suitable toothed reamer so as to leave the surface of the holes clean and rough and shall be filled with mortar as specified in paragraph 5-11(a)., immediately upon removal of the forms. Wire ties will not be permitted without the approval of the contracting officer, and at no time where the concrete surface will be exposed to weathering and where discoloration will be objectionable. All forms shall be so constructed that they can be removed without hammering or prying against the concrete. Unless otherwise indicated, suitable moldings shall be placed to bevel or round exposed edges, at expansion joints and/or any other points as may be required by the contracting officer.

(c) Coating. - Forms, except those lined with absorptive form lining, shall be coated with a non-staining mineral oil which shall be applied shortly before the concrete is placed.

(d) Removal. - Forms shall not be removed without the approval of the contracting officer, and all removal shall be accomplished in such manner as will prevent injury to the concrete. Forms shall not be removed before the expiration of the minimum number of days indicated below, except when specifically authorized by the contracting officer. When, in the opinion of the contracting officer, conditions on the work are such as to justify it, forms may be required to remain in place for longer periods.

| | |
|---|---|
| Arches, beams and slabs | 14 days |
| Columns | 7 days |
| Walls and vertical faces | 2 days |

(e) Absorptive Form Lining. - In addition to the requirements for work specified above, the forms for all permanently exposed surfaces, of lock walls and approach walls, not covered by backfill, and galleries and culverts through the lock shall be constructed of matched lumber, approved by the contracting officer, and line with absorptive lining. The absorptive form lining shall be capable through its absorptive capacity of eliminating voids, pits and other common defects from the surface of the concrete placed against it. The form lining shall be highly absorptive to air and water and shall possess surface characteristics such as will result in a dense concrete with a satisfactory surface texture, and the minimum amount of sticking of the lining upon removal of the forms. The lining shall be readily adaptable to cutting, fitting and any other operation necessary in connection with its use. The lining itself, and any coating or treatment employed in its manufacture, shall be such as will not create discoloration or interfere with the normal chemical reactions of the cement in the concrete. The type of lining shall be subject to the approval of the contracting officer. Tests shall be made by the contractor of all proposed absorptive lining as directed by the contracting officer. These tests shall include the use of absorptive form lining on concrete surfaces which will be later covered by backfill. Samples shall also be furnished to the Government for laboratory tests, before approval of any type of lining by the contracting officer. Horizontal joints will not be permitted in absorptive form lining except at horizontal construction joints in the concrete unless otherwise directed or approved by the contracting officer. Other joints in absorptive form lining shall be made only where directed or approved by the contracting officer. For cutting and trimming the absorptive lining, the contractor shall use tools which are well adapted for this work and are maintained in such condition that smooth edges will be produced. The joints between the sheets of absorptive form lining shall be fitted smoothly and accurately, and patching of the sheets of absorptive form lining will not be permitted. At joints the edges of the form lining shall be in contact but shall not be pressed tightly together. Absorptive form lining shall be attached to the forms with only a sufficient number of nails or other means to hold the lining snugly in contact with the surface of the forms, and free from bulges and other imperfections that might cause unevenness or roughness of the concrete surfaces. Nails shall be driven so that the under side of the nailheads will be flush with the surface of the absorptive lining, and care shall be taken not to make dents in the surface of the lining with hammers or in any other manner. After the absorptive lining has been nailed in place, the joints shall be rubbed with a smooth tool to make the joints smooth and to press down any projecting fibers. In tightening the form anchors where absorptive form lining is in contact with the face of a previous lift, sufficient pressure shall be applied to compress the lining at the surface of contact so as to compensate for the reduction in thickness of the lining not in the surface of contact which will be caused by the pressure of the freshly placed concrete. Insofar as practicable, the contractor shall avoid splashing mortar or concrete on the absorptive lining and shall remove, without damage to the lining, such coatings as have set or become dry before the concrete is placed against the lining. Absorptive form lining of fibrous materials shall be used only once unless otherwise approved by the contracting officer. After being used it shall be removed from the site of the work or disposed of as approved by the contracting officer. Forms lined with absorptive lining shall, in general, be removed or loosened early enough to avoid difficulty from sticking; except, the form shall be allowed to remain in place for a sufficient length of time to provide adequate support for the concrete, as determined by the contracting officer. Fibers from the lining which adhere to the concrete when the forms are removed, shall be removed without damage to the concrete, by brushing or other suitable means, as approved by the contracting officer. At all times subsequent to delivery of the absorptive form lining and prior to the placing of concrete against the lining, the contractor shall take all precautions necessary to protect the lining from becoming damp or wet to such an extent as to damage the material or to reduce its effectiveness as an absorptive medium. Particular care shall be exercised to protect absorptive form lining during clean-up operations, and temporary protection of such lining will be required. The use of absorptive form lining which has become wet or which contains visible external defects such as holes, ragged or untrue edges, breaks, cracks, tears, protuberances or indentations, will not be permitted.

5-14. PLACING STEEL REINFORCEMENT. -

(a) General. - All reinforcing steel will be furnished to the contractor by the Government (see paragraph 1-10). The contractor shall unload, transport and place all steel reinforcement, including rods, fabric and structural shapes as indicated on the drawings or otherwise required. The contract unit price for "Steel Erection; Concrete Reinforcing," shall include unloading, hauling to site, cleaning, proper storage and straightening, if necessary. All reinforcement shall be, when surrounding concrete is placed, entirely free from loose, scale, dirt, grease or other coating which might destroy or reduce its bond with the concrete. All placing shall be in accordance with drawings furnished or approved by the contracting officer.

(b) Cutting and Bending. - Steel reinforcement will be cut and bent to the required length and shapes at the mill. Miscellaneous bending that may be required at the site shall be in accordance with standard approved practice and by approved machine methods. Bar lists and bending schedules will be furnished by the Government.

(c) Quality. - The steel reinforcing will conform to the requirements of paragraph 9-16.

(d) Minimum Spacing of Rods. - The spacing of rods shall be as indicated on detail drawings to be furnished by the Government later. The clear distance between parallel rods shall not be less than 1½ times the diameter of round rods, or twice the side dimensions of square rods, but in no case shall the clear spacing between the bars be less than 1½ times the maximum size of the coarse aggregate used in the concrete, unless specifically authorized by the contracting officer.

(e) Relation of Rods to Concrete Surfaces. - Except where otherwise indicated, reinforcement shall be placed as follows:

(1) All main reinforcement in massive concrete sections shall be placed not less than 4 inches from any concrete surface, unless otherwise specifically indicated or authorized.

(2) All main reinforcement in walls and slabs of buildings exposed to the weather and in fire-resistant construction, shall be placed not less than 1 inch from the surface in walls and slabs, 1½ inches in floor beams, and 2 inches in girders and columns. In interior flat slab construction, the minimum cover may be reduced to 3/4 inch. For interior work where fire hazard does not exist, the main reinforcement shall be placed not less than 3/4 inch from the surface in walls and slabs, 1 inch in floor beams, and 1½ inches in girders and columns.

(3) The covering of stirrups, spacer rods, and similar secondary reinforcement may be less than the above dimensions by the diameter of such rods. The above dimensions shall be measured from the face of the reinforcement to the face of the forms.

(f) Splicing. - Where splices in reinforcement, in addition to those indicated on drawings or directed by the contracting officer, are necessary, there shall be sufficient lap to transfer the stress by bond. Rods shall be lapped not less than 40 diameters and splices shall be staggered. The lapped ends of rods shall be separated sufficiently or connected properly to develop the full strength of the rods. Adjacent sheets of fabric reinforcement shall be spliced by lapping not less than 6 inches, the lapped ends being securely wired together. The expense caused by any laps other than those indicated on the drawings or directed to placed by the contracting officer, which are provided for the convenience of the contractor, shall be borne by the contractor.

(g) Supports. - All reinforcements shall be secured in place, true to the lines and grades indicated, by use of metal or concrete supports, spacers or ties as approved by the contracting officer. Such supports shall be of sufficient strength to maintain the reinforcement in place throughout the concreting operation, and shall be used in such a manner that they will not be exposed on the face of, nor in any way discolor not be noticeable in the surface of the finished concrete. The cost of furnishing and placing all supports, spacers, ties and/or other devices required for reinforcement shall be included in the contract unit price for "Steel Erection: Concrete Reinforcing."

(h) Protection for Future Use. - Exposed reinforcement intended for bending with future work shall be protected from corrosion by heavy wrapping of burlap saturated with bituminous material, or by other approved means.

## 5-15. EMBEDDED ITEMS.

(a) Before placing concrete, care shall be taken to determine that any embedded metal or wood parts are firmly and securely fastened in place as indicated. They shall be thoroughly clean and free from coating, rust, paint, scale, oil, or any foreign matter. The embedding of wood in concrete shall be avoided whenever possible, metal being used instead. If wood is allowed, it shall be thoroughly wetted before the concrete is placed. Any air or water lines or other materials embedded in the structure as construction expedients shall conform to the above requirements and upon completion of their use shall be back-filled with concrete or grout as directed by the contracting officer. No payment will be made for such items nor for backfill of the items.

For the placement of structural steel, gate frames, etc., see Sections VII and VIII.

## 5-16. EXPANSION AND CONTRACTION JOINTS.

(a) General. - Expansion and contraction joints shall be constructed between concrete monoliths and at such other points with such dimensions as shown on the drawings or required by the contracting officer. The method and materials used shall be subject to the approval of the contracting officer and the materials shall conform to current Federal Specification wherever applicable. In no case shall corner protection angle or other fixed metal embedded in the surface of the concrete and bonded, be continuous through an expansion joint.

(b) Built-up Joint Filler. - Joints between dam monoliths shall contain a built-up joint filler where indicated on the drawings and as described below unless otherwise directed by the contracting officer; the area of the joint between the metal water stop and the upstream face of the dam; areas of the joint between surfaces of the galleries and the surrounding metal water stops; and in other places, a strip 18 inches wide adjacent to final exposed surfaces. The filler shall consist of one thickness of 30 lb. asphalt-saturated roofing felt (See paragraph 9-03), joined to the concrete on each face of the joint by a uniform trowelled layer of bituminous cement Type "B" (See paragraph 9-19(a)).

(c) Water Stops, Bituminous and Metal. - Metal water stops at the upstream face of the dam at vertical joints shall be backed up by six inch diameter wells filled with special bituminous filler, type "C" and containing a steam heating unit, all as detailed and shown on the drawings.

The six-inch wells shall be formed by halved concrete pipe on one side of the well. The halved concrete pipe shall be non-reinforced, and of bell and spigot pattern, and shall conform to Federal Specification SS-P-371. The minimum thickness of shell shall be one inch and depth of socket two inches. The halved or split faces shall be smooth and in one plane.

As the structure progresses in height, sections of the steam heating unit shall be installed in the wells, and the wells shall be filled solid with bituminous material. The special bituminous filler, type "C" shall conform to the requirements of paragraph 9-19 (b). After completion of the dam, each vertical joint shall be heated by steam until the bituminous material is melted, and additional bituminous material shall then be introduced from the service gallery under pressure until no more can be added under pressures up to 100 pounds per square inch or as directed by the contracting officer. This filler will be supplied from the service gallery through a 4-inch wrought iron pipe. Inside this feeder pipe, and extending in a continuous circuit from the bottom to the top of the six-inch well, shall be placed the 3/4-inch wrought iron steam pipe for use as a heater coil to soften the bituminous filler. At the joints in the bulkheads the 4-inch wrought iron pipes shall extend beyond the face of the gallery wall and shall be fitted with flanges as shown on the drawing. The wrought iron steam pipes and 3/4-inch nipple for supplying bituminous cement shall extend 2 inches beyond the flange on the 4-inch pipe and shall be threaded and capped. At the joints in the spillway the 4-inch pipe shall open into a cover recess in the top of the pier and be similarly fitted with flanges and with caps for the 3/4-inch nipple. All wrought iron pipe shall be genuine wrought iron conforming to the requirements of paragraph 9-26.

The metal water stops shall be of 16-gage corrugated black sheet iron 26-inches wide conforming to the requirements of paragraph 9-17, painted with bituminous paint, and crimped and bent as shown on the drawings. The ends of the strip shall be joined together and made watertight by welding which shall be subject to the approval of the contracting officer.

The bottom of each water stop at monolith contraction joints shall be embedded 6 inches in firm rock and recess filled with mortar and mortar allowed to harden before placing first lift of the foundations. Immediately after removal of the form, the exposed metal water stops, concrete pipe, and steam pipe shall be protected by boxes approved by the contracting officer.

Other water stops of 16-gage corrugated black sheet iron, conforming to the requirements of paragraph 9-17, and painted with bituminous paint, crimped and bent as shown on the drawings, shall be installed around gallery openings at contraction joints and elsewhere as indicated on the drawings, or as otherwise required.

If supply conditions at the time of construction permit the use of copper water stops, the contracting officer may direct that they be substituted for the corrugated iron strips. In such event the contractor shall furnish and install the copper strips and the contract price will be adjusted for any difference in cost in accordance with Article 3 of the contract. Copper strips, if used, shall conform to Federal Specification QQ-C-501 and Amendment 1.

5-17. PRECAST POROUS CONCRETE DRAINS. - Precast porous concrete drains of the size and dimensions detailed shall be placed as indicated on the drawings. The porous concrete shall be mixed in the proportion of one part of Portland cement to five parts of aggregate by weight, the amount of water being such (a water-cement ratio of 0.33, plus or minus, by weight) that the resulting cement paste will not fill the voids in the aggregate but will thoroughly coat and bind the aggregate particles. The aggregate used shall all pass a screen having 3/4-inch square or equivalent round openings and shall all be retained on a screen having 3/16-inch square or equivalent round openings. The compressive strength of the porous concrete at seven days, as determined by tests of 6-inch by 12-inch cylinders made and tested in accordance with the latest standard specifications of the American Society for Testing Materials, shall be not less than 1000 lbs. per square inch. The porosity of the concrete at seven days shall be such that water will pass through a slab of the concrete 12 inches thick at the rate of not less than seven gallons per minute per square foot of slab, with a constant 4-inch depth of water on the slab. Cement and aggregates for porous concrete will be furnished by the Government. Payment for constructing and placing the precast porous concrete drains will be made at the contract unit price per lineal foot for "Drains; Porous Concrete."

## 5-18. MEASUREMENT AND PAYMENT.

(a) Concrete, General. - Measurement of concrete will be made on the basis of the actual volume of concrete within the neat lines of the structures as indicated on the drawings or otherwise required. Measurement of concrete placed against the sides of the excavation without the use of intervening forms will be made only within the neat lines of the structure. No deductions will be made for rounded or beveled edges or space occupied by metal work, electrical conduits, timber, nor for voids which are either less than five (5) cubic feet in volume or one (1) square foot in cross section. Unless otherwise specified, payment for concrete will be made at the respective contract prices per cubic yard for the various classes required, which prices shall include the use of all equipment, tools, material, false-work, forms and form lining, bracing, bolts, rods, metal ties, dowels, canvas, mortar, labor, special provisions for hot and cold weather placing and curing, and all other items required to complete the concrete work.

(b) Additional Concrete. - Any other concrete to be placed and not specifically covered above will be paid for at that contract unit price for the concrete specified above which is most applicable to the additional concrete placed as determined by the contracting officer. The decision of the contracting officer regarding the classification of such additional concrete will be final. No payment will be made for any additional material which may be authorized by the contracting officer at the request of and primarily for the benefit of the contractor, which is not found necessary and required and directed by the contracting officer under the provisions of these specifications.

(c) Measurement and Payment for Steel Reinforcement. - Steel reinforcement will be paid for at the contract unit price per pound for "Steel Erection; Concrete Reinforcing." The weights for payment shall be based on the amount actually placed in accordance with the dimensions and details on the bar schedules furnished by the Government or placed as directed by the contracting officer. Unit weights used in determining computed weights will be as follows:

| Size of Bars, Inches | Weight, Pounds per Foot |
|---|---|
| 3/8 round | 0.376 |
| 1/2 round | 0.668 |
| 1/2 square | 0.850 |
| 5/8 round | 1.043 |
| 3/4 round | 1.502 |
| 7/8 round | 2.044 |
| 1 round | 2.670 |
| 1 square | 3.400 |
| 1-1/8 square | 4.303 |
| 1-1/4 square | 5.313 |

(d) Measurement and Payment for Water Stops. - Payment for furnishing and installing the bituminous cement in the wells in the water stops will be made at the contract unit price per cubic foot for "Special Bituminous Filler, Type "C" measured in place to the section indicated or required. Payment for furnishing and installing the corrugated iron water seals will be made at the contract unit price per pound for "Corrugated Iron Water Stops" and shall include all costs of painting, crimping, joining the ends, placing, protecting, and embedding in the foundations and sealing with grout. The payment for furnishing and placing the following items will be made at the contract unit price as follows: per pound for "Pipe; Wrought Iron," and per lineal foot for "Pipe; Concrete, Halved."

## SECTION VI

## BRIDGE AND ROADWAY

6-01. GENERAL. - The bridge crossing the structure will be of reinforced concrete construction. The roadway extends over both bulkheads as well as over the spillway, and is of similar construction throughout. The clear spans on the bulkheads are 26 feet and on the spillway are 25 feet. The gantry track extends over the spillway and the first bay of each bulkhead. Over the spillway, the upstream rail is carried by a de p curtain wall and the downstream rail by the main wall of the spillway structure. On the bulkheads, each rail is carried by a concrete girder. Between the roadway and the downstream gantry rail there are fixed hoists for the eight control gates. A concrete slab covers the space between hoists. Expansion joints shall be provided as indicated on the drawings.

6-02. CONCRETE. - The slabs, girders and curbs shall be of Class "A" concrete. Forms shall be provided with absorptive form lining as described in paragraph 5-13(e). Forms shall be cambered for dead load deflection as directed by the contracting officer, and shall be rigidly supported to avoid any sag in horizontal lines or surfaces.

6-03. CONCRETE FINISHING. -

(a) Pavement. - After the concrete in the roadway has been brought to a true uniform grade it shall be struck off with a heavy template to the cross-section indicated on the drawings. The pavement shall receive a wood float finish as specified in paragraph 5-11. Prior to final finishing operations, the surface shall be tested for trueness of surface and grade and any deviation exceeding one-eighth of an inch in ten feet shall be immediately corrected.

(b) Curbs. - The curbs shall receive a wood float finish as specified in paragraph 5-11. The edge shall be finished by a steel edging tool to a smooth dense surface.

6-04. MISCELLANEOUS. -

(a) Roadway Drains. - The contractor shall furnish and install roadway drains complete as shown on the drawings. The drains shall be located and dimensioned as shown on the drawings, and the material shall conform to the applicable requirements of Section IX.

(b) Bridge Guard Rail. - A guard rail shall be furnished and erected at the edges of the roadway, as shown on the drawings. The posts shall be 6-inch rolled steel H-beams anchored in the concrete and the two rails shall be 2½ inch standard steel pipe welded to the posts (see paragraph 9-24). The web at the upper end of each post shall be cut away from the flanges, the top of the web cut to a semicircle and the flanges curved and welded to the web to form a cap as indicated on the drawings. A slip joint shall be provided in each pipe rail at each expansion joint in the roadway.

(c) Handrailing. - (See paragraph 11-12).

(d) Paints and Painting. - (See Section X).

(e) Electric conduits pertaining to the power and lighting system shall be as specified in Section XI or shown on the drawings.

(f) All pipes (except pipe railing)and/or conduits which cross expansion joints shall be fitted with suitable water-tight sleeves, satisfactory to the contracting officer, to allow for expansion and contraction at the joint. The weight of the sleeves will be included in the weight for the pipe or conduit of which they form a part.

6-05. PAYMENT. -

(a) Payment for the bridge concrete will be made at the respective contract unit price per cubic yard for the class required and will include the cost of finishing the concrete surfaces.

(b) The weight of cast iron roadway drains, furnished and installed, shall be included in the bid item "Iron; Cast," and payment will be made at the contract unit price per pound for that item.

(c) Payment for furnishing, installing, and painting the bridge guardrail, including pipe railing, posts and anchorages will be made at the contract unit price per lineal foot for "Bridge Guard Rail". Measurement for payment will be made along the top rail from center to center of posts.

## SECTION VII

## GATES, HOISTS, GANTRY CRANE, AND APPURTENANCES

### 7-01. GENERAL. -

(a) Scope of Work. - The work covered by this section comprises the unloading, hauling, storing, erecting, painting, placing and testing of the control gates, stop logs, control gate hoists, downstream stop log hoist, and the gantry crane, together with all appurtenances, anchor bolts, fitting up bolts or other required fittings for the foregoing items. Placing of any items requiring grouting in place shall include the grouting. All necessary fitting, adjusting, riveting and welding shall be included in the price for erection. All permanent wiring, except as specified in Section 7-04(b), will be done under another contract. Field riveting and welding shall be in accordance with paragraph 11-03 and field painting shall be in accordance with Section X.

(b) Material and Equipment. - The material and equipment to be erected including rivets and permanent connecting bolts will be furnished by the Government, see paragraph 1-10. The contractor shall furnish the construction plant and all field paint, lubricating materials, welding rods, fitting-up bolts, tools, appliances and any other items incidental to handling, storing, erecting, painting and testing.

### 7-02. ORDER OF WORK. -

(a) Placement of certain items of material and equipment will be required during the first stage of construction and placement of the remainder will not be required until the fifth (last) stage. The work to be done under all sections of this contract during each of the five stages is explained in paragraph 2-02. The items required under this section for the first stage and those required for the fifth stage are listed in (b) and (c) below.

(b) First Construction Stage. - Erection and placement of the following items are required during the first construction stage:

(1) One travelling gantry crane.
(2) One upstream stop log lifting beam.
(3) 108 temporary upstream stop logs.
(4) 44 permanent upstream stop logs.

(c) Fifth Construction Stage. - Erection and placement of the following items are required during the fifth construction stage:

(1) Eight control gate seats, including roller tracks, seal bars and supports, and upstream guides.
(2) Eight conduit liners.
(3) Eight pairs of control gate dogs.
(4) Eight control gates.
(5) Eight control gate hoists.
(6) One downstream stop log hoist.
(7) One downstream stop log lifting beam.

7-03. UNLOADING AND HANDLING. - All material and equipment shall be carefully handled during unloading and placing in final position so that no parts will be bent, broken or otherwise damaged. Hammering or wedging that will distort or injure the members will not be permitted, and members shall not be overstressed during the process of unloading, handling and erection. The contractor shall unload all material promptly upon arrival at the site, otherwise he shall be responsible for demurrage charges and/or damages. (See paragraph 1-10.) He shall check all material turned over to him against shipping lists and report any shortage or damage discovered promptly in writing to the contracting officer. If the sequence of operations requires it he shall store all material under cover and protect it from the elements until it is placed in final position.

7-04. GANTRY CRANE. -

(a) Description. - The gantry crane runway will extend from the south end of the electrical bay in the south bulkhead to the north end of the repair bay in the north bulkhead. The crane will be of 35 ton capacity with a single hook. The gantry structure will be of structural steel box sections supporting a single trolley, and the trolley runway will be entirely enclosed by a sheet steel housing. The gantry drive will be by means of a motor in each of two of the gantry trucks. Power will be supplied to the crane by means of a flexible cable on a reel mounted under the downstream lower sill and which may be connected to any of several power outlets along the runway.

(b) Erection. - The contractor shall adhere to the best modern practice and workmanship in the erection and testing of the crane. He shall make all adjustments necessary for satisfactory operation, shall service all machinery units, make all electrical connections and place the crane in first class operating condition.

(c) Use by the Contractor. - The contractor is expected to use the crane to handle the upstream stop logs during construction, and will be permitted to use it in doing any work under this contract for which it is suitable on condition that he shall provide competent operators and proper care for the crane until the completion of the contract. He shall also provide any necessary temporary electric service lines and power for crane operation (see paragraph 1-11). Before the final contract payment is made the contractor shall, if required by the contracting officer, repaint the crane and make good to the satisfaction of the contracting officer any damage to it that may have resulted from the contractor's use thereof.

7-05. UPSTREAM STOP LOG LIFTING BEAM. - The upstream stop log lifting beam will be shop fabricated and assembled. The contractor shall store the beam or attach it to the crane hook as directed by the contracting officer.

7-06. TEMPORARY UPSTREAM STOP LOGS. - As these stop logs are for temporary regulation of flow and are not required to be water-tight, a reasonable amount of leakage will be permitted. They will be of structural steel with timber sheathing and belting seals. The steel frames will be completely shop fabricated and furnished by the Government. The contractor shall furnish and attach (after painting the frames) the timber sheathing and seals, together with lag screws and holding bolts, in accordance with paragraph 2-07(b) of these specifications, and shall store the stop logs or place them directly in the slots as directed by the contracting officer.

7-07. PERMANENT UPSTREAM STOP LOGS. - These stop logs will be of structural steel with rubber seals. They will be completely shop fabricated, but the seals will be shipped separately. After painting the stop logs the contractor shall attach the seals to form water-tight joints and shall store the stop logs or place them directly in the slots as directed by the contracting officer.

7-08. DOWNSTREAM STOP LOG HOIST. - The downstream stop log hoist will be a monorail electric hoist of standard manufacture and of about 2000 pounds capacity. The contractor shall install the hoist in operating position on the monorail.

7-09. DOWNSTREAM STOP LOG LIFTING BEAM. - The downstream stop log lifting beam will be a steel strut suspended horizontally by a chain sling from the hoist and equipped with hooks for engaging the stop logs. The ends will be guided in the stop log slots. The contractor shall store the lifting beam or attach it to the hoist as directed by the contracting officer.

7-10. CONTROL GATE SEATS. - The control gate seats for each gate opening consist of two vertical embedded structural steel members carrying the side seal bars and the roller train bearing track, two horizontal members carrying the top and bottom seals, and two striking plates on which the adjusting pins on the bottom of the gate will rest when the gate is closed. Each horizontal member and each vertical member will be completely shop fabricated, the four members will be assembled with turned bolts, and the surfaces to which the roller train bearing plates and the seal bars are attached will be accurately machined. The assembly will then be taken apart and shipped. The contractor shall re-assemble the members in the gate opening, bolt the conduit liner to them, accurately adjust the whole assembly to line and grade, and hold it in this position until the concrete to be placed during the fifth construction stage has set. He shall make all welds required for watertightness at the joints and shall attach the roller train bearing plates and seal bars. The striking plates shall be accurately set to grade and grouted in place.

7-11. CONTROL GATE GUIDES BELOW ELEVATION 206. - After the gate seats have been concreted in place and the guides above Elevation 206 set, the guide angles on the upstream side of each gate slot shall be adjusted to the proper distance from the vertical roller train bearing plate and to make a smooth joint with the upstream guide above Elevation 206 (see paragraph 8-12) by means of the anchor bolts embedded in the concrete, and shall then be grouted in place.

7-12. CONDUIT LINERS. - The conduit liners will be of structural steel plates with welded-on stiffeners and connection angles. Each liner will be shop fabricated in convenient shipping pieces with provision for bolted splices. The contractor shall assemble the liners in place, bolt all splices and the connections to the gate seat members and hold the whole assembly to correct line and grade as specified in paragraph 7-10.

7-13. CONTROL GATE DOGS. - A pair of dogs will be provided for each gate at the top of the guides at elevation 244. The contractor shall accurately set the bases for the dogs, bolt them securely in place, and install the dogs on their bearings. In setting the bases, the contractor shall do any reaming, welding and adjusting required for an accurate alignment and spacing. The bearings shall be greased if required.

7-14. CONTROL GATES. - The control gates will be of the tractor type with inclined sealing surfaces. They will be completely shop fabricated and shipped complete with roller trains. The contractor shall install each gate in its slot and shall carefully adjust and lock the adjusting pins at the bottom so that pressure between the sealing surfaces on the gate and those at the edges of the conduit opening will be only sufficient to form an effective water seal when the pins are carrying the weight of the gate on the striking plates set in the concrete. With the gate in this position and the pins adjusted there shall be no appreciable tendency for the gate to force itself upstream due to wedging action against the sealing surfaces at the conduit opening.

7-15. CONTROL GATE HOISTS. - The gate hoists will be of the drum and cable type, electrically operated. The hoist frame will span the gate opening at the deck level and will rest on bearing plates set in the concrete of the downstream roadway girder and the downstream wall of the spillway structure. Anchor details will be such that the hoists may be easily removed and replaced by the gantry crane. The contractor shall set and anchor the hoists, connect the lower sheave blocks to the gates, service all machinery units, connect power leads, make any necessary adjustments and place the hoists in first class operating condition.

7-16. ERECTION ENGINEERS. - The contracting officer will require the manufacturers of the crane, control gates and hoists each to furnish an erection engineer to supervise and direct the erection or installation and the testing of the equipment which he furnishes. The contractor shall place all of his men who are working on the erection of this equipment under the supervision and direction of the erection engineers. The services of the erection engineers will be paid for by the equipment manufacturers.

7-17. TESTING. -

(a) General. - The contractor shall make the tests required under (b) and (c) below and necessary adjustments in the equipment all under the direction of the manufacturers' erection engineers as specified in paragraph 7-16. Tests shall be repeated until the operation of each item is satisfactory to the contracting officer.

(b) Control Gates and Equipment. - The operation of the control gates shall be checked by lowering and raising each gate several times throughout its full range by means of its hoist, and by supporting it on the dogs. In addition, each hoist shall raise and lower at the specified speeds and hold in any position a test load 25% in excess of its rated capacity under both manual and automatic control.

(c) Gantry Crane. - The crane shall raise, lower and transport on the runway at the specified speeds and hold in any position a test load 25% in excess of its rated capacity.

7-18. MEASUREMENT AND PAYMENT. -

(a) Payment for erecting the hoists and the gantry crane will be made at the contract lump sum price for "Hoists and Gantry Crane: Erection."

(b) Measurement for payment for erecting and placing in final position the control gates, control gate seats, control gate guides below Elevation 206, control gate dogs, and the conduit liners will be on the basis of scale weights except that no payment will be allowed for weights more than 4% in excess of the theoretical weight. Payment will be made at the contract unit price per pound for "Control Gates: Erection."

(c) Measurement for payment for placing the permanent upstream stop logs, the temporary upstream stop logs exclusive of timber, seals and connections (see paragraph 11-16), the upstream and downstream stop log lifting beams and the downstream stop log hoists will be on the basis of scale weights except that no payment will be allowed for weights more than 4% in excess of the theoretical weight. Payment will be made at the contract unit price per pound for "Miscellaneous Equipment: Placing."

## SECTION VIII

## STRUCTURAL STEEL

### 8-01. REQUIREMENT. -

(a) General. -

(1) The work covered by this section comprises the unloading, hauling, storing, erecting, placing and painting of the items listed in (b) and (c) below. Placing of any items requiring grouting in place shall include the grouting. All necessary fitting, adjusting, riveting, welding and placing of all anchor bolts, shims, wedges, connecting bolts, fitting-up bolts, or other fittings for the required items shall be included in the price for erection. Field riveting and welding shall be in accordance with paragraph 11-03 and field painting shall be in accordance with Section X.

(2) The material to be erected, except as noted below, including rivets and permanent connecting bolts will be furnished by the Government. The contractor shall furnish the construction plant and all field paint, welding rods, fitting-up bolts,, tools, appliances, and any other items incidental to handling, storing, erecting and painting.

(3) Erection of certain items will be required during the first stage of construction and the remainder will not be required until the fifth (last) stage. The work to be done under all sections of this contract during each of the five stages is explained in paragraphs 1-12 and 2-02. The items required under this section during the first stage and those required during the fifth stage are listed in (b) and (c) below.

(b) First Construction Stage. - Erection of the following items are required during the first construction stage:

(1) Guides and sills for the upstream stop logs.
(2) Rails for the gantry crane runway.
(3) Gantry crane stops.
(4) Control gate hatch frames and covers.
(5) Upstream stop log hatch frames.
(6) Deck expansion joint steel.
(7) Ladders (except as noted in (c))and metal stairs.
(8) Steel in electrical and repair bays.
(9) Access hatch frames and covers.
(10) Monorail hoist track columns.

(c) Fifth Construction Stage. - Erection of the following items are required during the fifth construction stage:

(1) Control gate guides above Elevation 206.
(2) Platforms at Elevation 244.
(3) Ladders in spillway section below Elevation 206.
(4) Monorail hoist track.

8-02. DRAWINGS. - The general arrangement of the material and equipment to be erected is as shown on the drawings. Complete erection drawings will be furnished the contractor by the contracting officer.

8-03. UNLOADING AND HANDLING. - All material and equipment shall be carefully handled during unloading and placing in final position so that no parts will be bent, broken or otherwise damaged. Hammering or wedging that will distort or injure the members will not be permitted, and members shall not be overstressed during the process of unloading, handling and erection. The contractor shall unload all material promptly upon arrival at the site, otherwise he shall be responsible for demurrage charges and/or damages. (See paragraph 1-10.) He shall check all material turned over to him against shipping lists and report any shortage or damage discovered promptly in writing to the contracting officer. If the sequence of operations requires it he shall store all material under cover and protect it from the elements until it is placed in final position.

8-04. GUIDES AND SILLS FOR UPSTREAM STOP LOGS. - The stop log guides will consist of built-up plate and channel sections lining the slots. The sills will be light H sections. Both guides and sills will be embedded in the concrete. Sixteen pairs of guides and sixteen sills will be required. The contractor shall set the guides in a vertical position and with the correct distance between the vertical Z-bars on the liner plates of the pair of guides in each stop log opening. The spacing of the guides shall be accurately maintained within the tolerance shown on the drawings. Particular care shall be taken to hold each guide in a truly plumb position and with the backs of the downstream channels in each pair of guides in a true plane. The sills shall be accurately set to grade, the ends welded to the guides, and the sill adequately supported until the concrete inclosing it has set.

8-05. CRANE RAILS. - The rails for the gantry crane runway will rest on bearing plates which will be set in grout slots left in the concrete and will be anchored by embedded bolts and rail clips at the bearing plates. Lateral adjustment will be provided by clearance in the clips. The rails shall be set on the base plates and anchored after the plates are leveled and adjusted to proper grade and alignment. Care shall be taken that the track gauge is accurately maintained, that the rails are truly level and at the correct elevation and that they are securely anchored. All splice bars and any other fittings shall be securely attached and the slots filled with grout.

8-06. GANTRY CRANE STOPS. - Stops for the gantry crane will be placed at each end of each crane runway rail. They will consist of structural steel members anchored in concrete and with striking plates to engage the bumpers on the crane trucks. The stops shall be set in position so that the crane bumpers will strike the two stops at either end of the runway simultaneously.

8-07. HATCH FRAMES AND COVERS. - The embedded steel framing for the control gate and upstream stop log hatches shall be set accurately to line and grade and held in position until the inclosing concrete has set. Covers for the control gate hatches with timber insulation in place as shown on the drawings, shall be put in position.

8-08. DECK EXPANSION JOINT STEEL. - Steel curbing and expansion details will be provided at all transverse joints in the deck and shall be set accurately in the concrete pour at the edges of the slabs.

8-09. LADDERS AND METAL STAIRS. - Ladders and metal stairs with all required and necessary fittings such as railing and grating treads shall be erected at locations shown on the drawings and securely anchored in place.

8-10. STEEL IN ELECTRICAL AND REPAIR BAYS. - Steel for support of equipment in the electrical and repair bays shall be accurately set to line and grade.

8-11. ACCESS HATCH FRAMES AND COVERS. - The hatches in the deck at Elevation 255 for access to the platforms below will be of standard sidewalk frame type with hinged covers. They shall be set accurately to line and grade and held in position until the inclosing concrete has set.

8-12. CONTROL GATE GUIDES ABOVE ELEVATION 206. - The guides above Elevation 206 will be supported by structural steel framing anchored to the downstream wall and tied in the concrete at Elevation 206 and to the platform supporting steel at Elevation 244. The guides will be adjustable by means of oversize holes for the anchor bolts at the bottom and by shims at the downstream wall anchors. The contractor shall align the backs of the downsteam guide channels with the roller train bearing plates in the guides below Elevation 206 and shall erect and firmly anchor the entire assembly in this position. The upstream guide angle below Elevation 206 will then be adjusted and grouted in. (See paragraph 7-11.) Care shall be taken that the surfaces on which the gate is to be guided are accurately joined. If necessary to secure a smooth joint, the contractor shall grind the ends of one or both guides as directed by the contracting officer.

8-13. PLATFORMS AT ELEVATION 244. - The bearing plates for the rolled steel supporting beams shall be accurately set to line and grade. The beams shall be placed and adjusted, connections to the gate guides made and the ends of the beams grouted in.

8-14. MONORAIL HOIST TRACK AND SUPPORTS. - The columns for the hoist track shall be set accurately to a plumb position in the concrete of the pier noses and in concrete anchors in the embankment. The contractor shall, at the start of the fifth construction stage, bolt on the supporting brackets and erect the monorail.

8-15. MEASUREMENT AND PAYMENT. - Measurement for payment for erecting in final position all items covered in this section of the specifications will be on the basis of scale weight except that no payment will be allowed for weight more than 4% in excess of the theoretical weight. Payment will be made at the contract unit price per pound for "Steel Erection: Structural", which payment shall cover all necessary material and work for erecting, placing and painting as indicated on the drawings or as called for in these specifications. No separate payment will be made for furnishing and placing timber insulation for the control gate hatch covers.

## SECTION IX

## MATERIALS

### 9-01. GENERAL.-

(a) Materials -

All materials shall be of new, unused stock, free from defects. Substitution of size of sections and materials from that shown on the drawings shall not be made except on written approval of the contracting officer and provided that the cost to the government shall not be increased thereby.

Materials indicated on the drawings or required in the work and not covered elsewhere in these specifications by detailed requirements shall conform to the requirements of this section.

Any materials required which are not covered by detailed specifications herein or elsewhere in the specifications shall conform to the applicable Federal Specifications, grade and/or class as required or, in cases where there are no applicable Federal Specifications, to applicable specifications of the American Society for Testing Materials (A.S.T.M.). In all other cases not specifically covered in these specifications the contractor shall furnish the highest grade commercial material or product.

(b) Inspection, Acceptance and Rejection of Materials

All materials shall be subject at all times to inspection by the contracting officer who will select such samples in such quantities as he may deem necessary, and subject the same to such tests as may be necessary to determine their qualities as herein specified. He will accept or reject materials in accordance with the results of such test. Tests may be repeated upon arrival of the various shipments at the site of the work to insure the acceptance of only such materials as will comply with the provisions of the plans and specifications.

(c) Test Specimens. - Special test specimens shall be furnished by the contractor on request and shall be of such shape and number as designated. They shall in general conform to Federal Specifications or to the Specifications of the American Society for Testing Materials as to shape, size and method of testing.

(d) Mill Test Reports. - Mill test reports certified by qualified technicians shall be furnished when required for all material entering into this work. They will, in general, be the basis of acceptance or rejection of the materials. The contracting officer may, however, require of the contractor special chemical or physical test on any part of the material if, in his opinion, the conditions justify such a test.

### 9-02. FEDERAL SPECIFICATIONS. -

Copes of Federal Specifications, referred to herein, may be procured from the Superintendent of Documents, Government Printing Office, Washington, D. C., at a price of five or ten cents each. When the term "Federal Specifications" or "A.S.T.M. Specifications" is cited, the reference shall be construed to mean the specifications as modified by any amendments promulgated before the date of opening bids for the contract. The number and designation of the Federal Specifications or A.S.T.M. Specifications for materials to be furnished under this contract are as hereinafter enumerated.

### 9-03. ASPHALT-SATURATED FELT. -

Asphalt-saturated felt shall conform to the requirements of Federal Specification HH-F-191, for "Felt; Asphalt-Saturated, (for) Flashings, Roofing and Waterproofing".

### 9-04. BOLT STEEL. -

Bolt steel shall conform to Federal Specification FF-B-571a and Amendment No. 1, dated April, 1935, for "Bolts; Nuts; Studs; and Tap Rivets (and Material for Same)," Class "B" steel, unless otherwise specified or required.

### 9-05. BUILDERS' HARDWARE. -

(a) Builders' hardware shall in general conform to the following Federal Specifications:

FF-H-106 and Amentment 1, dated November, 1934, for "Hardware, Builders; Locks and Lock Trim".
FF-H-116a for "Hardware, Builders; Hinges"

(b) Locks shall be of the pin-tumbler type, with not less than 5 tumblers, and shall be of weatherproof and moistureproof construction. (See also paragraph 11-15 (b). Padlocks shall conform to Federal Specification FF-P-101a and amendment 3, dated July, 1939, for "Padlocks", Type la, size 1-3/4 inches. All padlocks shall be legibly stamped "C. of E., U.S.A."

### 9-06. CAST IRON PIPE AND FITTINGS. -

(a) Pipe. - Unless otherwise indicated on the drawings or directed by the contracting officer, cast iron pipe shall conform to the specifications of the American Standards Association for Pit Cast Pipe for the class required. The pipe shall be furnished with standard coal-tar-dip coating. Ends shall be either plain, bell and spigot, or American Standard flanged, as required. Cast iron soil pipe shall conform to Federal Specification WW-P-401 for "Pipe and Pipe Fittings; Soil, Cast Iron." Threaded cast iron pipe shall conform to Federal Specification WW-P-356 for "Pipe, Cast Iron; Drainage, Vent and Waste (Threaded)".

(b) Threaded Fittings shall conform to Federal Specification WW-P-501a for "Pipe Fittings; Cast-Iron (Threaded)" of type and class as shown or required.

(c) Flanged Fittings shall conform to American Standards, class as indicated or required.

### 9-07. CAST IRON SAFETY TREAD. -

Cast iron safety tread shall conform in all respects to Federal Specification RR-T-661, for "Treads; Safety, Metallic," "Type "B" and Class 6. Safety treads shall have a minimum thickness of 5/16 inch and shall be of the lengths and widths shown on the drawings.

### 9-08. CHAINS AND ATTACHMENTS.

Chains and attachments shall conform to Federal Specification RR-C-271 and Amendment 2, dated November, 1934, for "Chain and Attachments; Standard, Miscellaneous". Chains shall be Type "A", Grade II, and as otherwise specified.

## 9-09. CONDUIT.

Rigid steel conduit, enameled, shall conform to Federal Specification WW-C-571 dated June 6, 1933, for "Conduit; Steel, Rigid, Enameled".

## 9-10. CORROSION-RESISTING STEEL.

Corrosion-resisting steel for air bubbler nozzles shall conform to Federal Specification QQ-S-763 for "Steel, Corrosion-Resisting; Bars and Forgings," Grade 6.

## 9-11. CREOSOTE.

Creosote for pressure treatment shall conform to Federal Specification TT-W-556 for "Wood-Preservative; Coal Tar Creosote (for) Ties and Structural Timbers". The pressure treatment shall conform to Federal Specification TT-W-571a for "Wood Preservative; Preservative Treatment".

## 9-12. EMBEDDED HANGER SUPPORTS.

(a) Embedded Inserts for pipe supports shall be for threaded rods similar and equal to the adjustable-loop type manufactured by the Grinnel Company.

(b) Expansion Shields and Sleeves for Pipe Supports shall be for threaded rods of the sizes shown on the drawings, and shall be of a type approved by the contracting officer.

## 9-13. IRON CASTINGS.

(a) Cast Iron shall in general conform to Federal Specification QQ-I-652 for "Iron, Gray; Castings", of class as required.

(b) Cast Malleable Iron shall conform to Federal Specification QQ-I-666 and Amendment 1, dated November, 1934, for "Iron, Malleable; Castings", Black (Ungalvanized) Type "S", and Zinc Coated (Galvanized) Type "B".

## 9-14. LOCK WASHERS.

Lock washers shall be of the "Kantlink" type and shall conform to the S.A.E. standard dimensions and requirements for lock washers of regular section. Material shall be either S.A.E. x 1055 or S.A.E. 1060.

## 9-15. METALLIC COATINGS.

Zinc coatings shall be applied in a manner and of a thickness and quality conforming to A.S.T.M. Specification, S-123-33 for "Zinc (hot galvanized) Coatings on Structural Steel Shapes, Plates, Bars, and Their Products". Sheradizing and cadmium plating shall have thickness and durability equal to or greater than zinc coating as specified above.

## 9-16. REINFORCING STEEL.

Reinforcing steel will conform to Federal Specifications QQ-B-71a, for "Bars; Reinforcement", (for) Concrete", Type "B" (Deformed). Bars will be of Grade 2 (Intermediate Billet Steel), or Grade 3 (Intermediate Car Axle Steel), The steel will be identified as to grade.

9-17. SHEET METAL.

Sheet metal shall conform to Federal Specification QQ-I-696 for "Iron and Steel; Sheet, Black and Zinc Coated (Galvanized)" of the type and class required. When so specified sheets shall conform also to definite chemical requirements.

9-18. SOLDER.

Solder shall conform to Federal Specification QQ-S-571 for "Solder; Tin-Lead", Grade "A" or "C" as specified or otherwise required.

9-19. SPECIAL BITUMINOUS CEMENT. -

(a) Type "B" shall be an internal set-up cement of asphaltic base, composed of a liquid asphaltic fluxing agent with an admixture of powdered asphalt, asbestos fibre and other suitable inorganic fillers. When mixed in the proper proportions, the cement shall be suitable for proper trowel application, and shall harden to a consistency, specified in subparagraph (3) below:

(1) The material shall be supplied in containers of proper relative size to apportion batches with the desired troweling consistency. The liquid asphaltic fluxing agent shall be a smooth uniform mixture, not thickened or livered, and showing no separation which cannot be easily overcome by stirring. The powdered cement shall be a uniform mix containing no matted lumps of fibre.

(2) When mixed in the proportions recommended by the manufacturer, the cement shall yield no less than 85 per cent of nonvolatile matter when 10 grams are heated in an oven at 105 to 110 degrees Centigrade for 24 hours.

(3) When tested in accordance with A.S.T.M. Specification D-5-25 for "Penetration of Bituminous Materials", the above mixture shall have the following characteristics:

Immediately after mixing, tested with a 5/8 inch diameter steel ball (114 grams) the mixture shall permit a penetration greater than 300 in 5 seconds. After 24 hour immersion in water at 25° C, the same specimen shall permit a needle penetration (100 grams) of not more than 100 in 5 seconds. After 30 day immersion in water at 25°C, the same specimen shall permit a needle penetration (100 grams) of not more than 50 in 5 seconds.

(b) Type "C" cement shall be an internal set-up cement as specified for Type "B", except that it shall have a melting point between 50 and 55 degrees Centigrade, and a needle penetration at 25° C of not less than 80.

9-20. STANDARD BOLTS, SCREWS AND PINS.

Bolts, nuts and studs shall conform to Federal Specification FF-B-511a and Amendment 1, dated April, 1935, for "Bolts; Nuts; Studs; and Tap-rivets, (and material for same)". Unless otherwise specified or required, bolts shall be of Type "B-2" and nuts of Class "C" steel, type "A-2", with class 2 free fit. Zinc or cadmium-coated bolts shall be furnished where required.

9-21. STEEL FLOOR GRATING AND FASTENERS.

Steel floor grating and fasteners shall conform in all respects to Federal Specification RR-G-661a Type I for "Gratings, Steel, Floor (Except for Naval Vessels)". Cross members shall be welded.

## 9-22. STEEL PIPE AND FITTINGS.

(a) Welded or Seamless Steel Pipe, Black or Galvanized, class, and coating as specified or required, shall be of standard commercial grade and sizes in conformity with Federal Specification WW-P-403a for "Pipe; Steel and Ferrous Alloy, Wrought, Iron-Pipe-Size", except that tests will not be required. Open ends shall be reamed. The pipe shall be straight, clean, and free from scale, rust, oil or other foreign matter.

(b) Fittings

(1) Screwed fittings shall be of standard weight, malleable iron, conforming to Federal Specification WW-P-521a for "Pipe Fittings; Malleable-Iron (Threaded), 150 pounds, black or galvanized as required, plain screw type fittings shall be of the same weight or grade as the pipe with which they are used.

## 9-23. STEEL WIRE ROPE.

Steel wire rope for guard rails shall conform to Federal Specification RR-R-571 and Amendment 4 dated January, 1941, for "Rope; Wire, of sizes and types as specified or otherwise required.

## 9-24. STRUCTURAL STEEL.

Unless otherwise specified, all steel for general purposes shall conform to Federal Specification QQ-S-711a, for "Steel, Structural, (for) Bridges", Class "A", except that the chemical properties shall be so controlled as to permit it to be easily welded by the arc-welding process.

## 9-25. TIMBER AND LUMBER.

(a) General. - All timber and lumber shall be straight, evensawed, sound and entirely free from all defects which might impair its durability or its usefulness for the purpose intended.

(b) Soft wood except as otherwise specified shall conform to Federal Specifications MM-L-751a and Amendment 1, dated April, 1938, for "Lumber and Timber; Softwood", yard lumber, grades as specified or required.

(c) Hardwood shall conform to Federal Specification MM-L-736 and Amendment 2, dated June, 1939, for "Lumber and Timber; Hardwood," yard lumber, grades as specified or required.

(d) Framing. - All timber shall be accurately framed and fitted and securely connected as shown on the drawings. Care shall be taken in framing to work out permissible defects wherever possible.

## 9-26. WROUGHT IRON PIPE AND FITTINGS.

Wrought iron pipe and fittings shall conform to Federal Specification WW-P-441a for "Pipe; Wrought-Iron, Welded, Black and Zinc-Coated", and shall be of classes and sizes as required. Open ends shall be reamed. The requirements in the specifications for steel pipe fittings shall apply also to wrought iron pipe fittings.

## 9-27. MEASUREMENT.

(a) The weights of structural steel members and of castings will be determined from the scale weight observed in the shop before shipment. If this weight is not available certified shipping weights will be used. The contracting officer may check these weights by calculations and no payments will be made for weight exceeding by more than 4 per cent (4%) the theoretical calculated weight. No weight allowance for painting will be made and the cost of painting shall be included in the unit price bid.

(b) Measurement of concrete reinforcing will be made in accordance with the provisions of paragraph 5-18 (c).

(c) All materials for which payment is not specifically provided elsewhere will be paid for on the basis of the unit measure, as listed in the schedules, at the unit bid prices.

## SECTION X - PAINTS AND PAINTING

10-01. GENERAL. The requirements set forth in this section include both shop and field cleaning and painting, but only the field cleaning and painting applies to this contract on those items furnished by the Government, see paragraph 1-10. Unless otherwise specified or authorized, all paint materials shall conform to the current Federal Specifications wherever applicable. Where Federal Specifications are not applicable, material shall be as specified, or otherwise subject to the approval of the contracting officer. All colors shall be as specified or subject to the approval of the contracting officer. All paint, when applied, shall provide a satisfactory film and a smooth even surface, except when sand reinforced, and undercoats shall dry without excessive gloss, suitable for the proper application and adhesion of subsequent coats, as approved by the contracting officer. Where necessary, in the opinion of the contracting officer, to suit the conditions of surface, temperature, and weather existing at the particular time of application, the packaged paint may be thinned by the addition of not more than one pint per gallon of mineral spirits (paragraph 10-10(a)) immediately prior to application, provided that in no case shall the viscosity of the paint be reduced to a point where the specified maximum coverages will be exceeded. To distinguish several paint coats of the same color the contracting officer may require the addition of carbon black to give each coat a different shade.

10-02. SURFACE CLEANING AND PREPARATION.

(a) Shop Cleaning. - Except as noted, all surfaces of control gates, steel stop logs and steel stop log frames, conduit liners, gate guides and supports, and other ferrous metal subject to immersion shall be thoroughly cleaned of all millscale and other foreign substances to base metal, by sandblasting or any other method approved by the contracting officer. All other exposed metal surfaces, except as noted, shall be thoroughly cleaned of all loose millscale and other foreign material by wire brushing and/or flame cleaning. This paragraph shall not apply to stainless steel, bronze, or machined surfaces.

(b) Field Cleaning. - All painted ferrous surfaces of gates, stop logs, liners, gate guides and supports, and other ferrous metal subject to immersion, shall be cleaned of all paint, rust, dirt, and other foreign matter by sand-blasting. All other shop primed surfaces shall be cleaned of dirt, oil or other foreign substances by the use of mineral spirts or other approved cleaning agents, immediately prior to the application of field coats, and all blisters and breaks in the paint film shall be cleaned to base surface by wire brush or scraper.

(c) Protection of Surfaces. - Care shall be taken to adequately protect all machinery parts, threads, and finished surfaces during cleaning and preparation.

(d) Inhibition. - No shop inhibitive treatment will be required. All surfaces cleaned in the field by sandblasting, or equally effective method, shall be treated with a chemical rust inhibitor (paragraph 10-07). The inhibitor shall be applied as soon after cleaning as practicable, and prior to formation of any forms of corrosion from atmospheric moisture, or other causes. The inhibitor shall be applied by brush and permitted to dry. This chemical inhibitor however, shall be applied only under conditions such that the temperature of the surfaces to which applied and the air in contact therewith, are between 50 degree F. and 110 degrees F., in order to insure proper chemical reaction with the metal.. After drying, any unneutralized reactive residue on the surfaces shall be removed by thorough wiping with wet cloths. The inhibited surfaces shall then be permitted to dry thoroughly and shall be brushed with a broom to remove the dry dusty reaction product, after which a standard priming coat of paint, as indicated, shall be applied as soon as practicable, but in any event prior to deterioration or destruction of the inhibited surface. Should the inhibited surface be damaged or destroyed at any point by any means whatsoever, the surfaces shall be cleaned and retreated in approved manner prior to application of the paint.

10-03. PAINT APPLICATION.

(a) All painting shall be done in a neat, thorough and workmanlike manner. Except where otherwise specified or specifically directed, all paint coats shall be applied by either brush or spray in such manner as to produce an even coating of uniform thickness completely coating all corners and crevices. All painting shall be done by thoroughly experienced workmen. Care shall be exercised during spraying to hold the nozzle sufficiently close to the surfaces being painted to avoid excessive evaporation of the volatile constituents and loss of material into the air. Paint shall be applied only to surfaces that are thoroughly dry and only under such combination of humidity and temperatures of the atmosphere and surfaces to be painted as will cause evaporation rather than condensation. A practical test is to wipe a damp cloth on the surface to be painted. If the moist streak dries promptly, conditions conducive to evaporation prevail. In no case shall any paint be applied to surfaces upon shich there is frost or moisture condensation, or during rainy or misty weather, without suitable protection as approved by the contracting officer. Painting during unfavorable weather conditions shall be carried on under a protective covering. While any painting is being done, the temperature of the surfaces to be painted and of the atmosphere in contact therewith shall be maintained at or above 50 degrees F. All paint when applied shall be approximately (within fifteen degrees of) the same temperature as that of the surface on which it is applied. Where protection is provided for paint-surfaces, such protection shall be preserved in place until the paint film has properly dried and removal of the protection authorized by the contracting officer. Items which have been painted shall not be handled, worked-on or other wise disturbed until the paint coat is completely dry and hard. After delivery at the site of permanent erection or installation, all shopprimed metal work shall be kept clean and free from corrosion. The surfaces shall be repainted or retouched from time to time, when in the opinion of the inspector it becomes necessary, using the same type of paint as the priming coat. Where field-painting at the site has been commenced on any portion of the work, the complete painting operation, including priming and finishing coats, on that portion of the work, shall be completed within 30 days after the date of such commencement. All coats on all painted surfaces shall be unscarred at the time of application of all succeeding coats, and when in the opinion of the contracting officer it becomes necessary, all coats shall be maintained by retouching or repainting, using the proper paints for the respective coats. After completion of painting, all glass, woodwork, and hardware and other surfaces not required to be painted shall be cleaned to the satisfaction of the contracting officer.

(b) Coverage. - The surface area covered per gallon for each type of paint specified shall be not greater than the following.

On smooth metallic surfaces:

| | | | |
|---|---|---|---|
| 1st Priming Coat | 600 | square | feet |
| 2nd Priming Coat | 425 | " | " |
| 1st and 2nd Finish Coats | 550 | " | " |

On sanded priming coat:

| | | | |
|---|---|---|---|
| Sanded Primer Coat | 425 | square | feet |
| 1st Finish Coat | 250 | " | " |
| 2nd Finish Coat | 300 | " | " |
| 3rd Finish Coat | 400 | " | " |

## 10-04. PRIMING COATS.

(a) Unpainted Surfaces. - The surfaces of all ferrous metal work to be embbed in the concrete stainless steel rollers and bearing surfaces, machined surfaces, surfaces requiring welding, and surfaces which will be in riveted contact shall not be painted unless otherwise specified.

(b) Shop Priming. -

(1) Unless otherwose specified all exposed ferrous metal shall receive one shop coat of Synthetic Red Lead Primer.

(2) Machinery and mechanical equipment (except threads and finished surfaces) subject to exterior atmospheric exposure, shall receive one shop coat of Synthetic Red Lead Primer.

(3) Interior machinery, mechanical and electrical equipment shall recieve at least one priming coat of an approved synthetic-varnish paint compatible with the synthetic enamel approved for finish coats.

(4) Machined surfaces shall, immediately after final inspection, be thoroughly cleaned of all foreign matter and coated with Rust Preventive Compound, U. S. Army Specification 2-84A.

(5) Screw Threads shall be protected by a coating of heavy oil.

(c) Field Priming. -

(1) All ferrous surfaces of control gates, stop logs, liners, gate guides and supports, and other ferrous metal subject to immersion and which are to be painted, shall be treated as follows: After cleaning by sandblasting, the surfaces shall be inhibited and painted with one coat of Synthetic Red Lead primer. In this coat, a heavy uniform course of perfectly clean sand (see paragraph 10-11(f)) shall be thoroughly and uniformly embedded within 15 minutes after application of the paint, or in any event before the paint has set to such extent as to prevent the proper embedment and adhesion of the sand particles. The sand shall be applied by air spray at reduced pressure or in any other manner which will insure thorough embedment of the maximum volume of sand particles without appreciable movement of the paint film. This coating shall be allowed to dry for a minimum of 48 hours prior to application of finish coats.

(2) All other surfaces shall receive a second priming coat of Synthetic Red Lead Primer after final erection in place in the structure. Surfaces which will be inaccessible after erection shall be painted prior there-to.

10-05. FINISH COATS.

(a) General. - Unless otherwise specified or authorized, the sand reinforced primed metal shall be given three coats of gray finish enamel. (See paragraph 10-06(d)). Exposed primed surfaces of all other metal work shall receive 2 coats of gray finish enamel. The priming coat over which it is applied shall be thoroughly dry and hardened, and at least a 24-hour interval shall be allowed between two successive finish coats and not less than 5 days for hardening of the final coat before being submerged in water. In any case, all finish painting shall be completed within 30 days after application of the first field-priming coat.

(b) Interior Mechanical and Electrical Equipment and parts for installation within buildings, and not subject to either water or atmospheric exposure, shall, unless otherwise specified or authorized, receive two coats of Heat Resistant Primer and Finish-Metal, except that parts not subject to temperature in excess of 150° F, may be given two coats of a high quality synthetic resin enamel, similar and equal to "Lustrlife" Enamel as manufactured by the St. Louis Surfacer and Paint Company, St. Louis, Missouri.

10-06. PAINTS AND PAINT FORMULAE.

(a) General. - Paints shall have the composition as indicated below and shall be of a color matching the color clips attached or as otherwise approved by the contracting officer. All paints, shall be guaranteed by the manufacturer not to get, liver or thicken deleteriously or form gas in a closed container within a period of one year from date of manufacture.

(b) Processing of Paints.

(1) Except where otherwise specified or authorized, all paint shall be made by grinding together dry or paste pigments and a liquid vehicle to form a smooth paint that will flow freely and will not settle or react deleteriously in containers.

(2) Grinding shall produce a fineness such that coarse particles and skins will not exceed 1.5 per cent (total residue left on No. 325 mesh screen, based on pigment . The grinding shall be done in a roll or pebble mill at temperatures that will not cause polymerization.

(3) Skinning shall be negligible after exposing 6 ounces of paint in a tightly closed 8 ounce glass container to sunlight for a total time of 24 hours.

(4) The resulting paint shall have satisfactory brushing and leveling properties, shall set to touch in not less than one hour nor more than four hours, unless otherwise specified, and shall provide a satisfactory film and a smooth even surface without undue gloss, suitable for proper application and adhesion of subsequent paint coats, as

approved by the contracting officer. Sufficient suitable driers shall be added to make the paint dry hard within 18 hours.

(5) In view of potential variations resulting from variable processing equipment and technique, the manufacturer may be allowed, where necessary to produce the specified viscosities, to make slight changes in formula proportions, subject to specific approval of the contracting officer.

(c) Synthetic Red Lead Primer, to be used under all gray enamel finish coats shall be composed of materials conforming, where applicable, to the specified requirements and mixed in the proportions as follows:

| | |
|---|---|
| Red Lead | 16.5% by weight |
| Iron Oxide | 38.2% |
| Zinc Yellow | 5.5% |
| Diatomaceous Silica | 6.0% |
| Vehicle (see par. 10-06) | 28.0% |
| Thinner | 5.8% |

The paint shall have a consistency of flow of between 25 and 40 seconds through the 0.15 inch diameter orifice of a standard consistency cup when tested in accordance with the procedure specified in paragraph 9 and 10 of A.S.T.M., Specification D 333-37 for "Methods of Testing Nitrocellulose Clear Lacquers and Lacquer Enamels." It shall have satisfactory brushing and leveling properties, shall set to light touch in not less than 2 hours nor more than 5 hours, and shall dry hard for recoating in not more than 18 hours, when tested in accordance with paragraph F-2d of Federal Specification TT-V-81a, entitled "Varnish; Mixing (for) Aluminum Paint." The vehicle shall be a synthetic resin varnish consisting of a phenol formaldehyde resin with the necessary oils and volatile thinners to produce elasticity, water-proofness, adherence, and durability in the finished paint film. It shall meet the detailed requirements of paragraph 10-08.

(d) Gray Finish Enamel. - Unless otherwise specified, all finish paint for all metal surfaces shall have the following composition and properties:

| | |
|---|---|
| Coloring pigments | 0.5 lbs. (approx.) |
| Lead Titanate | 3.0 lbs. |
| Magnesium silicate | 1.0 lbs. |
| Acicular Zinc Oxide | 0.25 lbs. |
| Vehicle (see paragraph 10-08.) | 1.0 gallon |

The paint shall have a consistency of flow of between 18 and 40 seconds through the 0.15 inch diameter orifice of a standard A.S.T.M. consistency cup. The enamel shall have good self leveling properties and when brushed or sprayed on a vertical surface at a coverage rate of 500 square feet per gallon shall dry hard and elastic without running, streaking, or sagging.

(e) Gray Heat Resistant Primer and Finish Paint for Metal shall have the following composition:

| | |
|---|---|
| Coloring Pigments | 1.0 pound (approx.) |
| Titanium Dioxide | 3.0 pound |
| Vehicle | 1.0 gallon |

Driers - sufficient approved driers to make the paint dry hard in 10 hours.

The vehicle shall be a glycerol-phthalate resin varnish of the following composition:

| | |
|---|---|
| Glycerol-Phthalate Resin Solution | 3/4 gallon |
| Mineral Spirits | 1/4 gallon |

The glycerol-phthalate Resin solution shall consist of 70 per cent by weight of glycerol-phthalate resin dissolved in 30 per cent by weight of xylol and shall be similar and equal to "Rezyl" No. 110, Solution No. "C", as manufactured by the American Cyanamide & Chemical Corporation, 30 Rockefeller Plaza, New York, N. Y.

10-07. CHEMICAL RUST INHIBITOR, to be used where specified or required, shall be an approved compound of water, a wetting agent, a viscosity agent, phosphoric acid, and sodium dichromate. The concentration of the solution at the time of application shall be such that the Orthophosphoric acid ($H_3PO_4$) content shall be between 7.0 and 9.0 per cent (by weight) and the Sodium Dichromate approximately 0.75 per cent. Commercial chemical rust inhibitors of compsoition somewhat different from this may be acceptable in lieu thereof, subject to approval by the contracting officer of results of approved tests showing that the inhibitor, when applied in accordance with instructions of the manufacturer, will indentically affect ferrous surfaces as the specified compound in the following ways:

(a) Chemically react with rust and surface metal to etch the surface, form a dull grayish coating of iron-chromate-phosphate, and produce a rust-inhibited surface receptive to the firm bonding of the priming paint.

(b) After initially being thoroughly dried, the inhibited surface shall show no deleterious rusting when subjected to light rain or to other dampening agency for a period of not less than 4 hours.

(c) Leave no unneutralized active chemicals on the surface.

10-08. PHENOLIC RESIN VARNISH VEHICLE shall conform to the following requirements:

(a) Oil-resin ratio shall be 33 gallons of oil to 100 pounds of resin.

(b) Shall be clear and transparent and entirely free from resin, estergum or other non-phenolic resins. Not less than 50 per cent by weight of the vehicle shall consist of non-volatile oil and resin.

(c) The resin content shall be 100 per cent para phenyl phenol-formaldehyde condensate similar and equal to Bakelite BR 254, and shall conform to the current U. S. Navy Department Specification 52R10 entitled "Resin Phenol-Formaldehyde."

(d) The volatile thinner shall contain not more than 80 per cent mineral spirits and not less than 20 per cent high flash coal tar naphtha or high flash hydrogenated petroleum naphtha and shall be free from toxic hydrocarbons such as benzol.

(e) The oil content shall be a ternary oil mixture composed of 40% linseed, 30% liquid oiticica, and 30% "dehydrated" castor oil.

(f) The flash point shall be not below 30° C. in a closed cup tester.

(g) Shall pass a Kaure Reduction Test of 120 per cent, using the method described in paragraph F-2g, Federal Specification TT-V-81a, for "Varnish; Mixing (for) Aluminum Paint."

(h) Shall show no skinning after 48 hours in a 3/4 filled, tight container.

(i) Flow- out films on tin plate panels dried 72 hours shall withstand immersion in cold water for 96 hours, and in distilled water at 200° F. for 7 hours without showing more than a slight haze which shall disappear within one hour, and shall show no other signs of deterioration. The panel shall be allowed to dry and cool for 15 minutes after removal from hot water and shall then be inspected for signs of failure.

## 10-09. PIGMENTS.

(a) Carbon Black shall conform to either Federal Specification TT-B-601, entitled "Boneblack; Dry, Paste-in-Japan, Paste-in-Oil" or Federal Specification TT-L-71 entitled "Lampblack; Dry, Paste-in-Japan, Paste-in-Oil."

(b) Lead Titanate shall be similar and equal to Titanox "L" as manufactured by the Titanium Pigment Corporation.

(c) Red Lead shall conform to Federal Specification TT-R-191a (97) per cent Grade for "Red Lead; Dry and Paste -in-Oil."

(d) Iron Oxide shall contain not less than 98 per cent $Fe_2O_3$ and shall not contain any organic coloring matter.

(e) Diatomaceous Silica shall be an approved commercial grade.

(f) Zinc Yellow shall contan not less than 40 per cent $CrO_3$. It shall be a basic zinc potassium chromate, soluble in acetic acid, free from lead compounds, and containing no added zinc oxide, and shall be stable or non-reactive with the pigments and vehicles specified.

(g) Titanium Dioxide shall be similar and equal to either "Ti-Pure O" as manufactured by Krebs Pigment & Color Corporation of "Titanox NC" as manufactured by the Titanium Pigment Corporation.

## 10-10. THINNERS AND SOLVENTS.

(a) Mineral Spirits shall have the following properites:

Gravity- - - - - - - - - - - - - - -43-47 degrees Baume
Flash Point (Closed cup) - - - - -100 degrees F. Min.
Initial Boiling Point- - - - - - -300-310 degrees F.
End Point- - - - - - - - - - - - - -405 degrees F. Max.
A.S.T.M. Copper Strip Test - - - -Negative
Solvency (Kauri-Butanol) - - - - -41 cc (a) 77 degrees F. Min.

(b) Dipentine shall have the following properties:

| | Maximum | Minimum |
|---|---|---|
| Specific Gravity at 15.5° C. | 0.854 | 0.845 |

| | | |
|---|---|---|
| Refractive Index at 20° C. | 1.477 | 1.472 |
| Unpolymerized Residue (percent (38N $H_2SO_4$) | 2.5 | |
| A.S.T.M. Distillation Range: | | |
| 5% Distilling at- - - - - - - - | 173 degrees C. | |
| 10% Distilling at- - - - - - - - | 175 degrees C. | |
| 97% Distilling at- - - - - - - - | 188 degrees C. | |
| Color-Lovibond 500 Amber - - - - | 3 | |
| Appearance: Clear and free from suspended matter. | | |

(c) Toluol shall conform to U. S. Navy Department Specification 52T7 entitled "Toluene (Toluol)", except that it shall have a solvency (Kauri-Butanol Method) of not less than 100 cc. at 77° F.

(d) Xylol shall conform to A.S.T.M. Specification D364-36 for "Industrial Xylene (Xylol) or 'Solvent Naphtha'", except that it shall have a solvency (Kauri-Butanol Method) of not less than 93 cc. at 77° F.

(e) Normal Butyl Alcohol (Butanol) shall conform to A.S.T.M. Specification D304-33 for "Butanol (Normal Butyl Alcohol)."

(f) Ethylene Glycol Monoethyl Ether shall conform to A.S.T.M. Specification D331-35 for "Ethylene Glycol Monoethyl Ether."

## 10-11. MISCELLANEOUS MATERIALS.

(a) Oil, Linseed JJJ-O-331 for "Oil; Linseed, Boiled, " or JJJ-O-336, for "Oil; Linseed, Raw," as specified or required.

(b) Insulating Varnish, U. S. Navy Department Specification 52-V-13b, entitled "Varnish; Insulating, (for) Electrical Purposes."

(c) Creosote Paint for surface treatment of timber shall conform to Federal Specification TT-W- 561a, entitled "Wood-Preservative: Creosote (for) Brush and Spray Treatment."

(d) Ortho-Phosphoric Acid ($H_3PO_4$), shall be a commercially pure product, in liquid form, containing not less than 75 per cent $H_3PO_4$.

(e) Sodium Dichromate, ($Na_2Cr_2O_7 \cdot 2H_2O$) shall be a commercially pure product in cystalline form containing not less than 85 per cent $Na_2Cr_2O_7$.

(f) Sand shall be perfectly clean, dry, de-dusted, silica sand particles, graded so that not more than 5% will be retained on a No. 30 mesh sieve and not more than 5% will pass a No. 50 mesh sieve, and shall be obtained by a wet-washing process.

## 10-12. INSPECTION.

(a) Unless otherwise specifically authorized, inspection of all materials for the paints and chemical rust inhibitor and the manufacture thereof, will be made by a representative of the contracting officer. All samples of materials and of the finished processed products will be tested and analyzed for conformity with the specifications by the Government. The inspector will collect for testing, samples of each of the materials to be used in the manufacturing processes and will then seal the material containers until test results from the samples indicated that the various materials conform to specifications. He will witness the breaking of the seals on the approved material containers and the compounding of the materials for the product being manufactured, will collect samples of the finished product for testing, and will witness the placing, sealing, and labeling of the finished product in containers for shipment. After the finished products have successfully passed the prescribed test, shipment of the sealed containers will be authorized.

(b) In the case of ready-mixed and packaged paints of standard manufacture, other than those specified by trade name, the contractor shall furnish a sample in the standard stock package, together with a certified copy of the complete chemical analysis, for test and approval by the contracting officer.

10-13. PAINT FOR MAINTENANCE. - To insure that paint used for maintenance after completion of the work shall match the original, the contractor shall furnish to the Government not less than one gallon and not more than ten gallons of each color used. The quantity of each color furnished shall be determined by the contracting officer from consideration of the severity of usage to which the surface on which it is applied is likely to be subjected.

10-14 PAYMENT for all paint and painting will be included in the contract price for the respective metals or items painted.

## SECTION XI

## MISCELLANEOUS ITEMS AND EQUIPMENT

### 11-01. AIR BUBBLER SYSTEM.

(a) General. - The contractor shall furnish and install complete, with all fittings and accessories except the compressor, the air bubbler system for the control gates. The supply pipe from the compressor shall be attached to the inside of the downstream wall of the spillway structure and one bubbler pipe complete with nozzle shall be attached to the supply pipe above each conduit opening at the vertical center line of the opening. The pipes shall be attached to the concrete by substantial straps and anchor bolts, either embedded or expansion type. The air compressor will be furnished and installed by others in the gate repair bay in the north bulkhead. Piping shall be of black steel, pickled to remove scale from the interior. Nozzles shall be of corrosion-resisting steel.

(b) Payment. - Payment for furnishing and erecting the air bubbler system complete with all required fittings will be made at the contract lump sum price for "Air Bubbler System."

### 11-02. AIR VENT GRILLS AND SUMP PUMP SUPPORTS.

(a) General. - The air vents leading from the galleries to the top of the concrete structure and the vents in the spillway for operating gates shall be provided at the top with structural steel grills and copper wire mesh screens. Similar grills and screens shall be installed in the air inlet and outlet vents in the electrical and the gate repair bays. Anchor bolts and fittings shall be furnished as required and installed as shown on the drawings. Structural steel sump pump supports shall be furnished and installed in the galleries as shown on the drawings. Structural steel shall conform to the requirements of paragraph 9-24.

(b) Payment. - Payment for furnishing, painting, and installing air vent grills and sump pump supports, complete as shown on the drawings, will be made at the contract unit price for "Steel; Structural, Miscellaneous."

### 11-03. FIELD RIVETING, AND FIELD WELDING.

(a) Field Riveting. - The rivet sizes shown on the drawings are the actual size of the cold rivets before heating. All connections shall be accurately and securely fitted up before the rivets are driven. Drifting done during assembling shall be only such as to bring the parts into position and not sufficient to enlarge the holes or distort the metal. Rivets shall be driven with a pneumatic hammer and a pneumatic bucker used where practicable. Rivets shall be heated uniformly to a light cherry-red color and driven while hot. They shall not be burned or over-heated. When heated and ready for driving they shall be free from slag, scale and other adhering matter. When driven they shall completely fill the holes. Heads shall be of an approved shape, of full and equal sizes, free from fins, concentric with the shanks, shall have full contact with the surface of the member, and shall grip the assembled parts firmly together. Unless otherwise specified or authorized, countersunk rivets shall be chipped or ground flush. Loose, burned, badly formed, or otherwise defective rivets shall be replaced. In removing defective rivets care shall be taken not to injure the adjacent metal and, if necessary, they shall be drilled out. Calking or recupping of defective rivets will not be permitted. In any case when a cold rivet of the size specified cannot be entered with light tapping, the hole shall be reamed with a twist reamer.

(b) Field Welding. - Welding will be permitted only where specifically called for on the drawings or as authorized by the contracting officer. All pieces to be welded shall be free from rust, paint, or other foreign matter for a distance of not less than ½ inch back from the welding edge.

All welding shall be done by competent welders by the electric arc method, using a process which will exclude the atmosphere from the molten metal. The welding shall be done in a manner that will produce complete fusion with the parent metal. Unless otherwise specified, the applicable current codes, specifications and recommended practices of the American Welding Society shall govern all welding work. Certification of welders will not be required unless, in the opinion of the contracting officer, inspection of the work indicates that unsatisfactory welds are being produced. Deposited weld metal shall have corrosion, physical and chemical characteristics consistent with those of the base metal. Coated welding rods, if used, shall be of the heavily coated type.

### 11-04. ELECTRICAL CONDUIT SYSTEM.

(a) General. - Unless otherwise directed by the contracting officer, the general contractor shall furnish and install only that portion of the electrical conduit which is to be embedded in concrete.

(b) Workmanship. - Rigid metal conduit shall be installed in accordance with the requirements of the National Electric Code and to the satisfaction of the contracting officer. Ends of metal conduit shall be reamed to remove rough edges and burrs and all joints between lengths of conduit, and at switches, junction boxes and fittings shall be watertight and shall provide electrical continuity of the conduit run so that it can be effectively grounded. Open conduit ends shall be capped, except when work is in progress on the run, to exclude dirt and moisture. Conduit runs shall be pitched to provide suitable drainage and all low sections of conduit runs that may trap water shall be vented for drainage in a suitable manner. Any run of conduit extending through a construction joint,or changing from an embedded to an open run, shall extend not less than the threaded length plus 1 inch past the face of the concrete. All conduit bends shall have a radius not less than that recommended by the National Electric Code. Field bends may be used if of the proper radius and carefully made with suitable tools so that the conduit is not flattened. No threadless fittings or running thread couplings shall be used in conduit runs. All conduit terminations shall be threaded and sealed with pipe caps, couplings and pipe plugs or conduit bushings and metal discs, before concreting operations are commenced.

(c) Expansion Joints. - Where conduit runs cross structural expansion joints, conduit expansion joints of standard manufacture similar or equal to Crouse-Hinds Type XJ Condulets shall be provided. Grounding jumpers shall also be provided to insure electrical continuity in accordance with the National Electric Code.

(d) Conduit. - All conduit shall be rigid metal conduit, enameled on the inside and outside and shall conform to the requirements of paragraph 9-09.

(e) Conduit Fittings. - All conduit fittings shall be high test gray iron or malleable iron castings, enameled on the inside and outside, of the types and sizes specified or indicated. They shall be approved by the National Board of Fire Underwriters.

(f) Payment. - Payment for furnishing and installing metal conduit, including conduit fittings and supports, completely installed in place, will be made at the contract unit price per pound for "Conduit; Metal."

## 11-05. ELECTRICAL GROUNDING SYSTEM.

(a) General. - An electrical grounding system shall be furnished and installed, as shown on the drawings, for the protection of all machinery and equipment on the structure. Two ground cables shall be embedded in the concrete of the dam where directed, with 100 feet of each cable resting on the channel bed and with the upper ends exposed for connection to two longitudinal cables. Each embedded cable shall be of sufficient length for the complete installation, and the upper end, prior to attachment, shall be temporarily coiled and protected. No splices may be made in any ground cable.

The two longitudinal exposed cables shall extend the full length of the structure and shall be supported at intervals not exceeding 10 feet. Each of these longitudinal cables shall be connected to both of the embedded ground cables in an approved manner.

(b) Cable. - Ground cable shall be standard bare stranded annealed copper, single conductor. Size shall be as shown on the drawings.

(c) Payment. - Payment for furnishing the grounding system complete and in place as required will be made at the contract lump sum price for "Electrical Grounding System."

## 11-06. FLOOR GRATING.

(a) General. - In the bulkheads, floor grating shall be installed over the gutters which drain the electrical and gate repair bays and the galleries. This grating shall have 1" x 3/16" bearing bars. In the spillway, floor grating shall be used to surface the gate dogging platforms, and shall be designed for a uniform load of 200 lbs. per sq. ft.

(b) Payment. - Payment for furnishing and installing floor grating, accurately fitted and painted as required, will be made at the contract unit price per pound for "Floor Grating; Steel".

## 11-07. GALLERY AND PUMP SUMP DRAINS.

(a) Gallery Drains. - Cast iron bell and spigot pipe shall be furnished and installed as drains from the electrical and gate repair bays to the service gallery, and from sumps in the service gallery through the concrete, thence through the backfill and the downstream training wall, as shown on the drawings, to discharge into the canal below the spillway.

(b) Pump Sump drains. - Cast iron bell and spigot pipe shall be furnished and installed for connection to the sump pumps to be installed in the bulkheads by others. The pipe end for connection to the pump discharge shall have an American Standard flange. The pipe shall extend through the concrete and connect to the gallery drain in the backfill, as shown on the drawings.

(c) Pipe. - The pipe and fittings shall be coated inside and out with coal tar pitch varnish and shall conform to the requirements of paragraph 9-06. Joints shall be made with caulking jute and sulphurbase joint compound approved by the contracting officer.

(d) Payment. - Payment for furnishing and installing gallery and sump pump drains will be made at the contract unit price for "Pipe; Cast Iron."

## 11-08. GALLERY GUTTER DRAINS.

(a) General. - Cast iron pipe drains, located as shown on the drawings, shall be installed in the bulkheads as leads from the porous concrete drains to the gallery gutters.

(b) Payment. - Payment for furnishing and installing gallery gutter drains will be made at the contract unit price for "Pipe; Cast-Iron."

## 11-09. GUARD CHAINS AND MISCELLANEOUS BOLTS AND FORGINGS.

(a) General. - Forged steel guard chains, complete with anchors and hooks, shall be furnished and installed in openings left for their installation in the bridge guard rail. Chains shall be installed also at the head of gallery shafts and elsewhere as may be required. Miscellaneous bolts and forgings shall be furnished and installed as shown or required.

(b) Payment. - Payment for furnishing and installing guard chains complete, and for miscellaneous bolts and forgings when payment is not otherwise provided, will be made at the contract unit price for "Steel Forgings; Miscellaneous."

## 11-10. TIMBER HATCH COVERS.

(a) General. - The contractor shall furnish the material for, construct, pressure-creosote, and place the 16 timber covers for the upstream stoplog hatches. The planking shall be bolted. The material shall include all lumber, bolts, eye-bolts, lifting rings, washers and creosote. Lumber shall not be cut or bored after creosoting. The contractor shall also furnish the material for, construct and place the 8 temporary covers for the hoist openings at the control gate hatches. The material shall include all lumber, spikes, lifting bolts and washers. All hatch covers shall be placed as soon as practicable during the first construction stage.

(b) Payment. - Payment for furnishing, construction, treating where required, and placing the timber hatch covers with all required fittings will be made at the contract lump sum price for "Hatch Covers; Timber."

## 11-11. CABLE GUARD RAIL.

(a) General. - A two-wire guard rail shall be installed as located and detailed on the drawings. Posts shall be 8" diameter fir, sound and free from defects, and shall be pressure creosoted full length. All necessary cutting and drilling shall be done before creosoting. Cable shall fulfill the requirements of paragraph 9-23. Anchor rods, clamp bolts and all metal parts and fittings shall be galvanized iron. Posts shall be set plumb, evenly spaced and true to lines and grades required. Cables shall be drawn taut and fastened securely. Where necessary, cables may be neatly spliced or joined by means of metal sockets and poured zinc. Deadman type anchors shall be provided at the ends and at intervals not exceeding 600 feet.

(b) Payment. - Payment for furnishing and installing cable guard rail complete will be made at the contract unit price per lineal foot for "Cable Guard Rail." Measurement will be made from center to center of end posts plus an allowance of 15 feet for each anchorage.

## 11-12. PIPE HANDRAILING.

(a) General. - Handrailing with required and necessary fittings shall be furnished and installed on the spillway deck, on the dogging platforms above the gates, on the bridge at the downstream stoplogs, at the stairs to the service galleries and elsewhere as required. Handrailing shall be of standard weight black steel pipe conforming to the requirements of paragraph 9-22. Dimensions and supports shall be as indicated on the drawings. Connections shall be welded except where provision for expansion is necessary. In such cases, expansion joints satisfactory to the contracting officer shall be used.

(b) Payment. - Payment for furnishing and installing handrailing will be made at the contract unit price for "Handrailing; Steel Pipe," for the size and type required. Measurement for payment will be made along the top rial between centers of supports. The contract price shall include all necessary fittings, embedded supports, and expansion and anchor bolts. The contract price shall also include painting as specified in Section X.

## 11-13. PLUMBING.

(a) General. - The necessary embedded pipe and connections for the future plumbing system shall be furnished and installed as shown on the drawings. Joints in bell and spigot pipe shall be made with caulking jute and sulphur base joint compound approved by the contracting officer. Joints in steel or wrought iron shall be threaded. Open ends of joints shall be capped or otherwise protected to prevent clogging or damaging.

(b) Payment. - Payment for furnishing and installing plumbing under this contract will be made at the applicable contract price for "Pipe; Cast-Iron," "Pipe; Wrought-Iron," or "Pipe, Black Steel." Payment shall include the cost of furnishing joint materials and of making connections.

## 11-14. SAFETY TREADS.

(a) General. - Safety treads shall be furnished and installed in all concrete stairs. Treads shall conform to the requirements of paragraph 9-07.

(b) Payment. - Payment for furnishing and installing safety treads, complete with anchorages, will be made at the contract unit price for "Safety Treads."

## 11-15. STEEL DOORS.

(a) General. - Steel doors and frames shall be furnished and installed in location indicated on the drawings. The doors shall be of the hollow steel type with steel panels, and shall be of first-class materials and workmanship. Thicknesses shall be as shown on the drawings. Corners shall be mitered, welded and ground smooth to produce indiscernable joints. Frames and doors shall be reinforced and provided with recesses, cutouts, drilled or tapped holes, etc., as required to suit the hardware applied. The parts of the doors shall be so constructed as to be proof against water entering and remaining inside the tubular rails and stiles. The frames shall be securely anchored to the masonry and caulked against it. For this purpose an approved caulking compound (Vulcatex" or equal), matching the concrete in color, shall be used.

Doors and frames shall be set plumb and square and the doors shall fit to the satisfaction of the contracting officer. Doors shall be supplied with brass thresholds, and frames shall be equipped with screen door mountings.

(b) Hardware. - Finish hardware shall be of heavy construction and suitable for the doors. It shall conform to the requirements of paragraph 9-05. Hardware shall be fitted at the factory in a neat and workmanlike manner. Hinges shall be of wrought bronze with ball bearings. All doors shall have cylinder locks with 5 pin tumblers. There shall be furnished four keys for each lock, and four master keys, fitting all locks. Double doors shall have top and bottom flush bolts. All doors shall be provided with stops and hooks, bumpers and keepers.

## 11-16. STOP LOGS.

(a) Downstream Stop Logs. - The contractor shall furnish 108 stop logs of select, structural grade, long leaf yellow pine timber of nominal 14" x 14" size. (see pp 2-07 (a)) These shall be surfaced on four sides, and cut as required for handling. The stop logs shall be pressure-creosoted after all cutting and boring has been completed. Creosote shall be furnished by the contractor.

(b) Temporary Upstream Stop Logs. - The contractor shall furnish and attach to each of the 108 steel frames furnished by the Government (see paragraph 7-06), the timber sheathing and belting seals, together with all bolts, lag screws, clamp bars and other required fittings. Sheathing shall be prime, structural grade, long leaf yellow pine. Belting for seals shall be of thickness and material suitable for the purpose and may be of salvaged stock if approved by the contracting officer. In placing the sheathing sufficient space shall be left between the timbers to allow for swelling after immersion in water.

(c) Payment. - Payment for furnishing, fitting, and installing the downstream stop log timbers and the sheathing and seals for the temporary upstream stop logs, together with all required fittings, will be made at the contract lump sum price for "Stop Logs: Timber."

Invitation No.

MASSENA CANAL INTAKE WORKS

## STANDARD GOVERNMENT FORM OF BID
(Construction Contract)

---

(Place) ____________________

(Date) ____________________

To: The District Engineer,
U. S. Engineer Office,
Massena, New York.

1. In compliance with your invitation for bids dated ________________ ________ and subject to all the conditions thereof, the undersigned,

____________________________________________________________

a corporation organized and existing under the laws of the State of

____________________________________________________________

a partnership consisting of ________________________________

____________________________________________________________

____________________________________________________________

or an individual trading as ________________________________

____________________________________________________________

of the city of ____________________________________________

hereby proposes to furnish all plant, labor, and materials and perform all work required for the construction of the Massena Canal Intake Works, complete, at the locations shown and to the extent indicated, in strict accordance with the specifications, schedules, and drawings, for the consideration of the following prices:

### SCHEDULE OF BID ITEMS

| No. | Quantity | Unit | Designation | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | | Cu.Yd. | Excavation, Common | | |
| 2 | | Cu.Yd. | Excavation, Rock | | |
| 3 | | Sq.Ft. | Line Drilling | | |
| 4 | | Cu.Yd. | Earth Fill; Compacted, Class "I" | | |
| 5 | | Cu.Yd. | Earth Fill; Compacted, Class "II" | | |
| 6 | | Cu.Yd. | Earth Fill; Class "III" | | |

## SCHEDULE OF BID ITEMS (continued)

| No. | Quantity | Unit | Designation | Unit Price | Amount |
|---|---|---|---|---|---|
| 7 | | Cu.Yd. | Filter | | |
| 8 | | Cu.Yd. | Sand and Gravel Backing | | |
| 9 | | Cu.Yd. | Riprap; Dumped, Class "A" | | |
| 10 | | Cu.Yd. | Riprap; Dumped, Class "B" | | |
| 11 | | Lin.Ft. | Drilling; Grout Holes in Concrete | | |
| 12 | | Lin.Ft. | Drilling; Grout Holes in Rock 0 to 25 feet | | |
| 13 | | Lin.Ft. | Drilling, Grout Holes in Rock 25 feet or over | | |
| 14 | | Lin.Ft. | Drilling; Exploratory Holes in Rock, 0 to 25 feet | | |
| 15 | | Lin.Ft. | Drilling; Exploratory Holes in Rock, 25 to 50 feet | | |
| 16 | | Lin.Ft. | Drilling; Exploratory Holes in Rock, 50 to 100 feet | | |
| 17 | | Cu.Ft. | Pressure Grouting | | |
| 18 | | Cu.Ft. | Sand in Grout | | |
| 19 | | Cu.Ft. | Rock Flour in Grout | | |
| 20 | | M.F.B.M. | Timber, White Oak | | |

## SCHEDULE OF BID ITEMS

| Item No. | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Earth Fill; Cofferdams | Cu.Yd | 32,210 | $______ | $______ |
| 2 | Rock Fill; Cofferdams | " " | 164,000 | $______ | $______ |
| 3 | Unwatering Foundations | Sum | Job | $______ | $______ |
| 4 | Excavation: Common | Cu.Yd | 847,000 | $______ | $______ |
| 5 | Excavation: Rock | " " | 11,900 | $______ | $______ |
| 6 | Excavation; Borrow | " " | 666,000 | $______ | $______ |
| 7 | Line Drilling | Sq.Ft | 11,600 | $______ | $______ |
| 8 | Drilling 3" Exploratory Holes | Lin.Ft | 3,000 | $______ | $______ |

SCHEDULE OF BID ITEMS(continued)

| Item No. | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 9 | Drilling 6" Concrete Cores | Lin.Ft. | 500 | $ ______ | $ ______ |
| 10 | Drilling 6" Foundation Drains | Lin.Ft | 800 | $ ______ | $ ______ |
| 11 | Drilling Foundation Grout Holes in Rock | Lin.Ft | 10,000 | $ ______ | $ ______ |
| 12 | Drilling Foundation Grout Holes in Concrete | Lin.Ft | 1,000 | $ ______ | $ ______ |
| 13 | Core Boxes | Each | 200 | $ ______ | $ ______ |
| 14 | Providing Pressure Grouting Equipment | Sum | Job | ______ | $ ______ |
| 15 | Pressure Grouting | Cu.Ft. | 10,000 | $ ______ | $ ______ |
| 16 | Rock Flour in Grout | Cu.Ft | 2,000 | $ ______ | $ ______ |
| 17 | Sand in Grout | Cu.Ft | 2,000 | $ ______ | $ ______ |
| 18 | Earth Fill; Compacted, Class I & Class II | Cu.Yd | 1,086,000 | $ ______ | $ ______ |
| 19 | Additional Compaction | Square (100sf) | 250,000 | $ ______ | $ ______ |
| 20 | Fill, Class III | Cu.Yd | 381,000 | $ ______ | $ ______ |
| 21 | Filter | Cu.Yd | 51,000 | $ ______ | $ ______ |
| 22 | Riprap; Dumped, Class A | Cu.Yd | 20,000 | $ ______ | $ ______ |
| 23 | Riprap; Dumped, Class B | Cu.Yd | 77,600 | $ ______ | $ ______ |
| 24 | Sand and Gravel Backing | Cu.Yd | 17,000 | $ ______ | $ ______ |
| 25 | Rolled Gravel Surface | Sq.Yd. | 4,700 | $ ______ | $ ______ |
| 26 | Seeding | Acres | 10 | $ ______ | $ ______ |
| 27 | Concrete; Class A. | Cu.Yd. | 1,300 | $ ______ | $ ______ |
| 28 | Concrete; Class B | " " | 91,200 | $ ______ | $ ______ |
| 29 | Special Bituminous Filler; Type C | Cu.Ft. | 230 | $ ______ | $ ______ |
| 30 | Steel Erection; Concrete Reinforcing | Lb. | 3,000,000 | $ ______ | $ ______ |
| 31 | Steel Erections: Structural | " | 466,000 | $ | $ ______ |

| Item No. | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 32 | Steel; Structural, Miscellaneous | Lb. | 1,000 | $ ______ | $ ______ |
| 33 | Steel Forgings; Miscellaneous | Lb. | 200 | $ ______ | $ ______ |
| 34 | Control Gates; Erection | Lb. | 456,000 | $ ______ | $ ______ |
| 35 | Hoists and Gantry Crane; Erection | Sum | Job | ______ | $ ______ |
| 36 | Iron, Cast | Lb. | 6,500 | $ ______ | $ ______ |
| 37 | Pipe; Cast Iron | Lb. | 10,000 | $ ______ | $ ______ |
| 38 | Pipe; Wrought Iron | Lb. | 2,600 | $ ______ | $ ______ |
| 39 | Pipe; Black Steel | Lb. | 7,500 | $ ______ | $ ______ |
| 40 | Pipe, Concrete, Halved | Lin.Ft. | 1,000 | $ ______ | $ ______ |
| 41 | Drains; Porous Concrete | Lin.Ft. | 3,960 | $ ______ | $ ______ |
| 42 | Corrugated Iron Water Stops | Lb. | 11,600 | $ ______ | $ ______ |
| 43 | Cable Guard Rail | Lin.Ft. | 3,800 | $ ______ | $ ______ |
| 44 | Bridge Guard Rail | Lin.Ft. | 1,270 | $ ______ | $ ______ |
| 45 | Handrailing; Steel Pipe 2" | Lin.Ft. | 1,300 | $ ______ | $ ______ |
| 46 | Handrailing; Steel Pipe 1-1/2" | Lin.Ft. | 300 | $ ______ | $ ______ |
| 47 | Safety Treads | Lb. | 500 | $ ______ | $ ______ |
| 48 | Floor Grating; Steel | Lb. | 12,400 | $ ______ | $ ______ |
| 49 | Conduit; Metal | Lb. | 1,000 | $ ______ | $ ______ |
| 50 | Doors; Steel | Lb. | 1,450 | $ ______ | $ ______ |
| 51 | Air Bubbler System | Sum | Job | ______ | $ ______ |
| 52 | Stoplogs; Timber | Sum | Job | ______ | $ ______ |
| 53 | Hatch Covers; Timber | Sum | Job | ______ | $ ______ |
| 54 | Miscellaneous Equipment; Placing | Lb. | 470,000 | $ ______ | $ ______ |
| 55 | Electric Grounding System | Sum | Job | ______ | $ ______ |

NOTES: (a) All amounts and totals given above will be subject to verification by the United States. In case of variation between unit bid price and totals shown by bidder, the unit price will be considered to be his bid.

(b) All bids must be for the entire work and must have each blank space filled in.

(c) The quantities of each item of the bid, as finally ascertained at the close of the contract, in the units given and the unit prices of the several items stated by the bidder in the accepted bid, will determine the total payments to accure under the contract. The unit price bid for each item must allow for all collateral or indirect cost connected with it.

2. EXPERIENCE. (See Invitation for Bids, paragraph 15.)

3. STATEMENT ESTABLSIHING PERMANENT PLACE OF BUSINESS AND FINANCIAL STATUS. (See Invitation for Bids)

3. STATEMENT ESTABLISHING PERMANENT PLACE OF BUSINESS AND FINANCIAL STATUS. (See Invitatation for Bids( continued)

4. PLANT TO BE USED ON THE WORK. (See Invitation for Bids and paragraph 1-20 of the specifications.)

(a) Earth Work.

(1) Excavating Equipment

| No. | Type | Manufacturer | Capacity | Age | Condition |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

(2) Transporting Equipment.

| No. | Type | Manufacturer | Capacity | Age | Condition |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

(3) Embankment Equipment.

(a) Spreading and Rolling Equipment.

### (3) Embankment Equipment. (continued)

#### (a) Spreading and Rolling Equipment.

#### (b) Pumping and Watering Equipment.

### (b) Concrete.

#### (1) Batching Equipment.

| No. | Type | Manufacturer | Capacity | Age | Condition |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

#### (2) Transporting Equipment.

### (b) Concrete. (continued)

#### (3) Miscellaneous Equipment.

### (c) Drilling Equipment.

| No. | Type | Manufacturer | Capacity | Age | Condition |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

### (d) Grouting Equipment.

### (e) Compressed Air Equipment.

(e) Compressed Air Equipment. (continued)

(f) Pumping Equipment.

| No. | Type | Manufacturer | Capacity | Age | Condition |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

(g) Miscellaneous Equipment.

5. PLANT LAY-OUT (See Invitation for Bids). - The undersigned has attached herewith the plant lay-out prescribed in the Invitation for Bids.

6. PROGRESS CHARTS (See Invitation for Bids). - The undersigned has attached herewith the progress charts prescribed in the Invitation for Bids.

7. It is hereby warrented that in the event award is made to the undersigned there will be used in the performance of the work covered by the contract only such unmanufactured articles, materials, and supplies as have been mined or produced in the United States, and only such manufactured articles, materials, and supplies as have been manufactured in the United States substantially all from articles, materials, or supplies mined, produced, or manufactured, as the case

may be, in the United States except as noted below or otherwise indicated in this bid or authorized in the specifications.

8. The undersigned agrees, upon receipt of written notice of the acceptance of this bid within______ days after the date of opening of the bids, to execute the standard form of Government contract, in accordance with the bid as accepted, and give performance and payment bonds, with good and sufficient surety or sureties, for the faithful performance of the contract, and for the protection of all persons supplying labor and materials in the prosecution of the work, within ______ days after the prescribed forms are presented for signature.

9. The undersigned agrees to begin the work within ______ calendar days after date of receipt of notice to proceed, and complete it within ______ calendar days after date of receipt of said notice to proceed.

______________________________
(Bidder)

By____________________________
(Name and Title)

______________________________
(Business Address)

NOTE: Read Standard Government Instructions to Bidders before preparing this bid.

# ST. LAWRENCE RIVER PROJECT

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# FINAL REPORT

## 1942

DOCUMENTS Room

# MASSENA CANAL INTAKE WORKS ANALYSIS OF DESIGN

CORPS OF ENGINEERS, U.S. ARMY

U.S. ENGINEER OFFICE • MASSENA, NEW YORK.

APPENDIX III-15 (3)

# ST. LAWRENCE RIVER

# PROJECT

* * * * *

# FINAL REPORT

# 1942

# MASSENA CANAL
# INTAKE WORKS

# ANALYSIS OF DESIGN

CORPS OF ENGINEERS, U.S. ARMY

U.S. Engineer Office - Massena, New York

July , 1942

PART ONE - Massena Canal Intake Works, Analysis of Design.

PART TWO - Massena Canal Intake Works, Estimate of Cost.

# PART ONE

# MASSENA CANAL INTAKE WORKS

## ANALYSIS OF DESIGN

## ST. LAWRENCE RIVER

## MASSENA CANAL INTAKE WORKS
## ANALYSIS OF DESIGN

### INDEX

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| II | Design Loads |
| III | Unit Stresses |
| IV | Concrete |
| V | Description of Design |
| VI | Structural Design |
| VII | Water Control Equipment |
| VIII | Electrical Design |
| IX | Stability |
| X | Investigations of Overburden and Bedrock for Foundations and Excavations and Materials for Embankments, Cofferdams, and Concrete Aggregates |
| XI | Design of Embankments and Foundation for the Spillway |
| XII | Cofferdams and Diversion |

## SECTION I - INTRODUCTION

1-01. GENERAL. - This design analysis presents the basis of design for the Massena Canal Intake Works, a part of the development of the International Rapids Section of the St. Lawrence River. The preliminary design of this structure has been completed and contract plans and specifications have been prepared. Sufficient data regarding subsurface conditions is on hand so that it is believed that no changes in design will be required.

### 1-02. DESCRIPTION OF PROJECT.

(a) Location. - The Massena Canal Intake Works will be located at the head of the existing intake canal which leads to the power plant of the Aluminum Company of America. The site is on the south side of the St. Lawrence River about 5 river miles above the Long Sault Dam Site.

(b) Purpose. - The Massena Canal Intake Works will serve to control flowage into the present intake canal. It will maintain constantly regulated flow at all stages of the St. Lawrence River from present stage up to final pool elevation, no matter what the demand from the powerhouse may be. This will be accomplished by means of float well controls, located at the powerhouse end of the canal and just below the Intake Works, for the gate motors, any fluctuation of canal level operating to increase or decrease the gate openings.

(c) Existing Canal. - The existing intake canal is approximately 3 miles long from its entrance near the site of the Intake Works to the power plant at its lower end. The average bottom width is 175 feet and the average depth at the normal flow of 25,000 c.f.s. is 27 feet. There is little freeboard for storage and no spillway to waste excess flow.

(d) Structures. - The Massena Canal Intake Works will be a partly reinforced concrete outlet structure flanked by earth wing dams. The concrete structure will be built on the center line of a short diversion canal which is to be excavated just south of the present canal and which will join the river to the present canal just above the existing highway bridge. This diversion canal will serve as the permanent flowage, the present canal being closed by the new north wing dam. This central concrete gate house or spillway will house eight 9-foot by 14-foot tractor gates operated by individual electric hoists. There will be stoplog slots upstream and down stream from each gate and provision for installation of trashracks in the upstream slots. The deck will carry a roadway and an overhead traveling gantry crane. The dam will be 100 feet high above the rock foundation and 642 feet long from end to end of the concrete bulkheads which will be joined to the earth wing dams. The wing dams will be of compacted earth protected on the upstreams side with rock riprap and supplied on the downstream side with rock and gravel drainage protection.

### 1-03. PERTINENT DATA

(a) Approximate Principal Quantites.

| | |
|---|---|
| Excavation, Common | 847,000 cu.yds. |
| Excavation, Rock | 11,900 " " |
| Concrete, All Classes | 92,500 " " |
| Earth Fill | 1,470,000" " |
| Reinforcing Steel | 1,500 tons |
| Structural Steel | 233 tons |

(b) General Dimensions.

| | |
|---|---|
| Maximum height | 100 ft. |
| Net effective outlet area | 1,008 sq. ft. |
| Length overall of concrete section | 642 ft. |
| Combined length of earth wing dams | 3,600 ft. ± |
| Overall length | 4, 200 ft. |

(c) Outlet Control.

(1) Eight 9-foot by 14-foot vertical-lift individually-controlled tractor gates.

(2) Eight cable hoists for gate operation.

(3) One traveling gantry crane to handle stoplogs and for emergency operation or handling of gates.

(4) Steel stoplogs for the upstream slots

(5) Timber stoplogs for the downstream slots.

(6) An emergency standby gasoline-electric unit capable of supplying enough electric power to raise one gate, to lower all eight gates simultaneously, or to operate the gantry crane.

(7) Float well control equipment for full automatic regulation of flow through the gates.

(d) Ice Protection. - Air-bubblers will be provided to keep the surface water near the hoisting cables warmed by convection. The deep intake pool insures freedom from frazil ice trouble while the submerged outlets avoid floe ice trouble.

(e) Elevations.

| | |
|---|---|
| Top of dam (roadway crown) | 255.0 |
| Top of earth wing dams | 254.5 |
| Bottom of control gate openings | 177.0 |
| Top of control gate openings | 191.0 |
| Maximum pool | 249.0 |
| Minimum pool | 231.0 |
| Tailwater (controlled water level in canal | 201.0 ± |
| Bottom of canal | 170.0 |
| Rock Foundation (average) | 165.0 ± |

(f) Outlet Capacity. - 25,000 cub feet per second (at lowest pool).

(g) Bottom Width of Diversion Canal. - 262 feet.

1-04. INVESTIGATIONS. - In addition to drilling and probing already completed, the following investigations are expected to be made:

1. Field compaction studies.
2. Rock quarry and aggregate tests.
3. Foundation stress studies.
4. Hydraulic model tests.

## SECTION II - DESIGN LOADS

2-01. HYDRAULIC CONDITIONS. - The hydraulic conditions governing the design of Long Sault Dam also control the design of Massena Canal Intake Works except for tailwater. Normal tailwater is at Elevation 201, the controlled canal level. Minimum tailwater is at Elevation 170, the elevation of the bottom of the canal just below the Intake Works.

A memorandum dated February 14, 1941, from Mr. Guy A. Lindsay defined the hydraulic conditions governing the design loading of Long Sault Dam. The following excerpts from this memorandum define the hydraulic conditions governing the design of the Massena Canal Intake Works.

### ADDENDA TO SECTION II - DESIGN LOADS

The original February 14, 1941 memorandum was revised by a memorandum from Mr. Guy Lindsay, dated April 26, 1941, which altered the hydraulic conditions at Iroquois Dam but which did not affect conditions at the Massena Canal Intake Works.

2-02. "CONDITION NO. I.

(a) Headwater elevation to be such as to conform to second last paragraph of Engineering Report dated Ottawa, January 3, 1941:

> 'All the works in the pool below the control
> dam shall be designed to provide for full
> Lake Ontario level, but initially the pool
> shall be operated at maximum elevation 238.0.'

The maximum monthly mean level of Lake Ontario at Oswego in nature was Elevation 249.02 (May 1870). With present Outlet conditions, and with 3,200 c.f.s. diverted at Chicago the maximum monthly mean level of the lake would be Elevation 249.6[illegible]. Under Regulation of Lake Ontario (Method No. 5) the resulting maximum monthly mean water level would be Elevation 249.10.

Headwater level adopted . . . . . . . . . . Elevation 249.00

(b) ****************************************************

(c) Ice Pressure. - With extreme headwater taken as above and in view of the fact that the maximum level of Lake Ontario would occur in the month of May, no ice pressure need be considered under Condition No. 1.

2-03. "CONDITION NO. 2.

(a) Headwater Elevation. - Maximum monthly mean headwater elevation resulting from application of Regulation of Lake Ontario (Method No. 5) and backwater studies described in Document No. 4 (Ottawa, November 15, 1940) would occur in May 1931 with a flow of 200,000 c.f.s., under which condition headwater level would be Elevation 242.3. To allow for future channel enlargement and as a factor of safety to cover differences in actual backwater slopes and those figures, it would appear that maximum operating headwater level should be taken at . . . . . . . . . . . . . . . . . . . . Elevation 245.00.

(b) ************************************************************

(c) Ice Pressure. - With the above head and tailwater levels, ice pressure would be nil as this would occur in the open water season.

## 2-04. "CONDITION NO. 3.

(a) Headwater Elevation. - The maximum monthly mean elevation under ice cover conditions, after the ice cover has formed over the pool extending from the Long Sault Dam to Iroquois, based on Regulation of Lake Ontario (Method No. 5) and the backwater calculations described in Document No. 4, would occur in January 1874 with a flow of 217,000 c.f.s. and would be Elevation 238.5.

Full ice pressure might result under conditions as pertaining at the beginning of the ice forming period when the water level at the dam would be that resulting from open water friction losses only. The maximum water level at the Long Sault dam under these conditions would be about Elevation 242.3 (January 1st, 1862, Q = 221,000 c.f.s.).

To allow for future channel enlargement, it would appear that under these conditions the headwater level should be taken at . . . . . . . . . . . Elevation 245.00.

(b) ************************************************************

(c) Ice pressure. - Ice pressure under this condition should be taken at 10,000 lbs. per lin. ft. of dam acting at Elevation 245.00. - 1.00 = . . . . . . . . . . . . . . . . . . . . . . . Elevation 244.00."

## 2-05. SUMMARY.

Design Data for Massena Canal Intake Works

| Condition | Headwater level | Tailwater level | Ice Pressure (10,000#/lin. ft.) |
|---|---|---|---|
| 1 | El.249.00 | El.170.00 | nil |
| 2 | El.245.00 | El.170.00 | nil |
| 3 | El.245.00 | El.170.00 | El.244.00 |

Conditions Nos. 1 and 3 govern the design.

2-06. UPLIFT PRESSURES. - The Massena Canal Intake Works has been designed for uplift pressures of full headwater at the upstream toe and full tailwater at the downstream toe, both applied over two-thirds of the base area. An assumed uplift condition of tailwater elevation plus 50% of the difference between headwater and tailwater elevations at the upstream toe, decreasing to tailwater elevation at the downstream toe, and applied over the entire base area, was investigated. This condition was found to be less severe than that mentioned above at all levels, hence no plates were made for inclusion in the Analysis of Design. The stability of the structure is discussed in detail in Section IX.

## SECTION III - UNIT STRESSES

3-01. GENERAL. - The following unit stresses for concrete, reinforced concrete, and steel construction have been used in the design of the Massena Canal Intake Works. These Stresses are the same as those used in the design of the Long Sault and Iroquois Dams.

3-02. WORKING STRESSES FOR CONCRETE.

| Nature of Stress | 3400 lb. Concrete Class A lbs./sq.in. | 3000lb. Concrete Class B lbs./sq.in. |
|---|---|---|
| 1. FLEXURE | | |
| a. Extreme fiber stress in compression | 1225 | 1050 |
| b. Extreme fiber stress in compression adjacent to supports of continuous or fixed beams or of rigid frames | 1400 | 1200 |
| c. Extreme fiber stress in tension - Plain concrete only (to be used for massive sections such as monolithic arches, retaining walls, etc., not exposed to large temperature variations) | 70 | 60 |
| 2. AXIAL COMPRESSION | | |
| a. In short columns with lateral ties (banded columns) | 785 | 675 |
| b. In short columns with continuous spirals | 980 | 840 |
| c. Pedestals-Unreinforced-Gross section | 875 | 750 |
| d. Composite columns | 875 | 750 |
| 3. BEARING | | |
| a. Load over entire area | 875 | 750 |
| b. Load over partial area-maximum permissible | 1225 | 1050 |
| 4. COMBINED BENDING AND DIRECT STRESS-COMPRESSION IN EXTREME FIBER | | |
| In no case should the section be less than that required where axial load alone is considered using stresses in 2-a and 2-b above. | | |
| a. Spiral columns with entire section in compression | 1225 | 1050 |
| b. Spiral columns-Tension in section | 1225 | 1050 |
| c. Banded columns - Entire section in compression | 1050 | 900 |
| d. Banded columns-Tension in section (Short columns only, i.e. 1/r= 40 | 1225 | 1050 |
| e. Arches | 1225 | 1050 |

|  | 3400 lb. Concrete Class A lbs./sq.in. | 3000 lb. Concrete Class B lbs./sq.in. |
|---|---|---|
| 5. SHEAR |  |  |
| a. Beams-No web reinforcement nor special anchorage of longitudinal steel | 70 | 70 |
| b. Beams-No web reinforcement-Longitudinal bars specially anchored | 105 | 90 |
| c. Beams-Web reinforcement but longitudinal bars not anchored | 210 | 180 |
| d. Beams-Web reinforcement and longitudinal bars specially anchored | 315 | 270 |
| e. Flat slab-At critical section | 105 | 90 |
| f. Footings with hooked ends | 105 | 90 |
| g. Punching shear | 260 | 225 |
| h. Flat slabs-Beams at walls and openings-Torsional shear plus direct shear-Web reinforcement and longitudinal bars specially anchored | 525 | 450 |
| 6. BOND |  |  |
| a. Beams, slabs, and one-way footings Plain bars (where special anchorage is provided) | 140 | 120 |
| Deformed bars | 175 | 150 |
| b. Two-way footings-Plain bars | 105 | 90 |
| Deformed bars | 135 | 115 |
| c. Cold drawn steel wire | 70 | 60 |

3-03. WORKING STRESSES FOR STEEL.

| Nature of Stress | Maximum Stress | Formula Used |
|---|---|---|
| 1. TENSION |  |  |
| Rolled Steel, on net section | 18,000 |  |
| On the area of the nominal diameter of rivets | 13,500 |  |
| On reinforcing steel | 18,000 |  |
| 2. COMPRESSION |  |  |
| Rolled Steel, on short lengths or where lateral deflection is prevented | 18,000 |  |
| On gross sections of columns (with a maximum of 15,000# per sq. in.) |  | $\frac{18,000}{1+\frac{L^2}{18,000r^2}}$ |
| For main compression members, the ratio L/r shall not exceed 120, and for bracing and other secondary members, 200. |  |  |

### 3. BENDING

| | Maximum Stress | Formula Used |
|---|---|---|
| On extreme fibers of rolled sections, and built-up sections, net section, if lateral deflection is prevented | 18,000 | |
| When the unsupported length L exceeds 15 times b, the width of the compression flange, the stress in pounds per square inch in the latter shall not exceed | | $\frac{20,000}{1 + \frac{L^2}{2000b^2}}$ |
| The laterally unsupported length of beams and girders shall not exceed 40 times b, the width of the compression flange. | | |
| On extreme fibers of pins, when the forces are assumed as acting at the center of gravity of the pieces | 27,000 | |

### 4. SHEARING

| | Maximum Stress | Formula Used |
|---|---|---|
| On pins | 13,500 | |
| On power-driven rivets | 13,500 | |
| On turned bolts in reamed holes with a clearance of not more than 1/50 of an inch | 13,500 | |
| On hand-driven rivets | 10,000 | |
| On unfinished bolts | 10,000 | |
| On the gross area of the webs of beams and girders, where h, the clear distance between flanges in inches, is not more than 60 times t, the thickness of the web in inches | 12,000 | |
| On the gross area of the webs of beams and girders if the web is not stiffened where h is more than 60 times t, the greatest average shear per square inch, V/A, shall not exceed | | $\frac{18,000}{1 + \frac{h^2}{7200t^2}}$ |

### 5. BEARING

| | Double Shear | Single Shear |
|---|---|---|
| On pins | 30,000 | 24,000 |
| On power-driven rivets | 30,000 | 24,000 |
| On turned bolts in reamed holes | 30,000 | 24,000 |
| On hand-driven rivets | 20,000 | 16,000 |
| On unfinished bolts | 20,000 | 16,000 |
| On expansion rollers per linear inch, 600 times the diameter of the roller in inches. | | |

6. COMBINED STRESSES. - For combined stresses due to wind and other loads, the permissible working stress may be increased 33-1/3 percent, provided the section thus found is not less than that required by the dead and live loads alone.

7. MEMBERS CARRYING WIND ONLY. - For members carrying wind stresses only, the permissible working stresses may be increased 33-1/3 percent.

8. OTHER LOADS. - For members carrying ice loads and other special loading the permissible working stresses shall be as stated in the sections describing the structures involved.

## SECTION IV - CONCRETE

4-01. SCOPE. - This section deals with the factors affecting design of the concrete to be used in the Massena Canal Intake Works. Concrete standards are the same as for Long Sault and Iroquois Dams.

4-02. STRENGTH. - Compressive strengths at 28 days shall test as follows:

Average for any 25 consecutive cylinders

| Class | Lbs. per sq. in. |
|---|---|
| A | 3,400 |
| B | 3,000 |

Class "A" concrete will be used in the bridge and deck over the spillway and bulkhead, and in the floors of the electrical and gate repair bays.

Class "B" concrete, reinforced, will be used throughout the spillway except in the bridge, the deck, and the downstream gravity wall section. In the bulkheads, Class "B" concrete, reinforced, will be used in the walls of the electrical and gate repair bays and in the piers.

Class "B" concrete, unreinforced, will be used in all other parts of the bulkheads and spillway and in the gravity training walls.

4-03. AGGREGATE INVESTIGATIONS. - Surveys have been made of the available sources of fine and coarse aggregates in the vininity of the work. Suitable materials in sufficient quantity are available within economical distance. Detailed data on the materials are on file in the District Engineer Office, Massena, New York.

4-04. AGGREGATE CONTENT.

(a) General. - The volume of aggregates to be used in concrete will be that necessary to produce a dense mixture of the required workability. The individual mixes will be proportioned to produce a concrete of suitable workability, density, impermeability and the required strength, all without the introduction of an excessive amount of cement.

(b) Sizes. - Coarse aggregate will be graded and stored separately in three sizes:

(1) 3/16" to 3/4"
(2) 3/4" to 1-1/2"
(3) 1-1/2" to 3"

The maximum size of aggregate to be used in Class "A" concrete is 1-1/2 inches. Aggregate up to 3 inches in size will be used in Class "B" concrete.

4-05. MIXING WATER. - Reports from the U. S. Geological Survey indicate that water from the St. Lawrence River is satisfactorily free from injurious chemicals. It is ordinarily free from excessive amounts of suspended silt.

4-06. PROPORTIONING.

(a) Cement. - It is intended that the two classes of concrete to be used will have the following cement content:

| | |
|---|---|
| Class "A" . . . . . . . . . . . . . . . . . . | 5.0 to 6.0 bags/cu.yd. |
| Class "B" . . . . . . . . . . . . . . . . . . | 4.0 to 5.0 " " |
| Concrete placed under water . . . . . . . . | 6.5 " " (minimum) |

(b) Water. - It is intended that the maximum water content will be as follows:

| Class of Concrete | Per bag of cement<br>Gallons | Per bag of cement<br>Pounds |
|---|---|---|
| "A" | 5.5 | 45.8 |
| "B" | 6.5 | 54.1 |

In calculating the total water content in any mix, the amount of moisture carried on the surfaces of the aggregate particles will be included. In all cases, the amount of water to be used will be the minimum amount necessary to produce a plastic mixture of the strength specified and of the desired density, uniformity and workability. In general, the consistency of any mix will be that required for the specific placing conditions and methods of placement, and ordinarily the slump will be between 1/2 inch and 2 inches for class "B" concrete, and between 1-1/2 inches and 3 inches for class "A" when tested according to "Method of Test for Consistency of Portland Cement Concrete," of the American Society for Testing Materials.

4-07. MIXING AND PLACING.

(a) Mixing. - Mixing of concrete will be done in a plant having a capacity of 800 cubic yards per eight hours. The plant will include not fewer than two mixers, individually powered.

The plant will include facilities for thorough inspection and will provide close control over ingredients.

The minimum mixing times per batch will be as follows:

| Mixer Capacity - Cu.Yd. | Minimum Mixing time - minutes |
|---|---|
| less than 3/4 | 1-1/4 |
| 3/4 - 1-1/2 | 1-1/2 |
| 1-1/2 - 3 | 2 |
| greater than 3 | 2-1/2 |

Excessive overmixing will not be permitted.

(b) Placing. - Placing of concrete will be completed before initial set has taken place and within 45 minutes after the introduction of the mixing water. Concrete when placed will be between 40 and 75 degrees Fahrenheit in temperature. It is anticipated that artificial heating and cooling will be required. Surfaces for placing will be thoroughly cleaned and will be approximately horizontal. Typical lifts will be 5 feet but special measures will prevail at the foundation, in thin sections, and under some other conditions of placing. Mechanical vibration will be used to produce a dense surface.

4-08. CONSTRUCTION JOINTS. - Horizontal construction joints in the mass of the dam are to be continuous throughout the monolith. Vertical joints between monoliths will be edged with a built-up joint filler of felt and bituminous cement. This treatment is intended to prevent spalling. Where maximum protection is desired against water seeping through vertical joints, a bulkhead of corrugated iron is run across the joint. Further protection is secured by introducing bituminous filler under pressure as described in paragraph 5-16

4-09. ABSORPTIVE FORM LINING. - Absorptive form lining will be used on all permanently exposed surfaces in order to produce a dense surface.

## SECTION V - DESCRIPTION OF DESIGN

5-01. SCOPE. - This section is intended to give a detailed description of the design of various features of the Massena Canal Intake Works and reasons for selecting the type of design used in each case.

5-02. DESCRIPTION. - The Massena Canal Intake Works will be a reinforced concrete outlet works flanked by gravity concrete bulkheads keyed into earth wing dams. The present normal elevation of the power canal is approximately 201 which elevation must be maintained constant throughout the construction period and thereafter. Headwater elevation will therefore vary from the present Elevation 201 up to a possible maximum of 249. The concrete gate structure is so designed that the full required diversion flow of 25,000 c.f.s. will pass through the large spaces between the initial piers without any appreciable raise in headwater level or lowering of tailwater level, and the same maximum or lesser flows, as required by powerhouse demands, can be passed at all stages of construction. After the work is completed this flow regulation will be automatic. This critical regulation is mandatory because the short power canal has no extra freeboard to provide storage and no wasteway to bypass excess flow. The demands of the powerhouse are, of course, variable. The central reinforced concrete structure will house eight vertical lift tractor gates each 9 feet wide and 14 feet high. The gate sills will be at Elevation 177 and each gate will be centered in an initial diversion bay 25 feet wide, the space between the gate and the diversion opening walls being filled with concrete. Installation of the first two gates at the south end of the spillway structure, together with their hoists and automatic control equipment, will be started just before the Long Sault Dam pool is raised at the beginning of the closure stage. These two gates will be used in conjunction with the stoplogs in the remaining openings for regulation of flow until such time as additional gates may be added due to increased pool level and discharge. The remaining six gates will then be installed, one by one. The automatic controls will be actuated by float wells at the powerhouse and at the control works. These float wells will be so interconnected, electrically, that "hunting" of the gates will be minimized. For a final solution, detailed studies should be made. In the final analysis, the use of a spillway below the Intake Works should be considered or a sluice gate where the ice gates at the Aluminum Company Powerhouse are now located. The bridge of the gate structure will carry a 20-foot concrete roadway. It will provide a platform to support the individual gate hoists and will also carry a traveling gantry crane for gate maintenance, stoplog handling and miscellaneous service. There will be no common housing over the gate hoists but each hoist will be inclosed by a weatherproof metal covering. There will be a stilling basin just downstream from the gates, and a hydraulic jump will be induced to dissipate energy. Stoplog slots are placed upstream and downstream from each gate so that the gate chambers may be pumped out. The upstream stoplog slots are designed so that trash racks may be installed in them at any time if it is found that screening is necessary. Space has been provided for operation of a mechanical rack rake by the gantry crane. The gates will be of the self-closing tractor or Broome type with steel plate lined outlets shaped to minimize cavitation. Each gate, or all gates selectively, will be opened and closed automatically through float well controls so that tailwater will be kept near constant level. Being deeply submerged, the gates themselves will require no ice protection. It is not anticipated that ice will form in the inclosures, but piping for air bubblers to keep the hoist cables clear in case ice does form will be installed. If the use of air bubblers is found necessary, a compressor may be easily connected and the bubblers put in operation. At either side of the gate structure will be a mass concrete bulkhead of standard design. Each of these bulkheads will be 186 feet long. Investigations showed that bulkheads of this length would be more economical than shorter bulkheads with consequent high retaining walls. Each bulkhead will be built in four monoliths so arranged that a joint will fall at the right point to make possible the special program of construction planned. This is explained in paragraph 5-09. Horizontal inspection and grouting galleries are provided.

5-03. GROUTING. - The entire concrete structure will rest on rock which will be systematically grouted through holes drilled from the lower inspection gallery of the bulkheads and through the slab of the spillway, first on 10-foot centers and more closely if tests indicate the necessity. The grout curtain will extend a short distance beyond the end of the south bulkhead, and will cross the bed of the existing channel to the north. Grout pipes will be embedded near the bottom of the mass concrete downstream wall of the spillway section for the purpose of grouting the joint between the bottom of the wall and the concrete slab which will be placed during the fifth construction state. Outlets to the joint will be at 5-foot centers in both directions. The grout will consist of a mixture of Portland cement, sand, and water. The high head differential warrants the same care and thoroughness in the design and construction as will be employed for the Long Sault Dam.

5-04. FOUNDATION DRAINS. - A system of foundation drain holes 30 feet on centers will be drilled underneath the bulkheads just downstream from the grout curtain. These drain holes will extend up into the grouting gallery where they will be fitted with means for measuring the actual hydrostatic pressure. Any drainage from the foundation will then be free to run or to be pumped from the grouting gallery to the downstream face of the dam. Provision is also made for draining the foundation under the spillway as shown on the plans.

5-05. CONCRETE DRAINS. - Porous concrete drains will be placed vertically on 6-foot centers near the upstream face of the bulkheads to intercept any possible seepage through this face. They will drain into the galleries and seepage will run or will be pumped to the tailwater.

5-06. GALLERIES. - The service gallery through the bulkheads is located at Elevation 218, well above the highest possible tailwater. It is intended for inspection purposes and as a means of servicing the monolith joint water-stops. Each of the water-stops consists of a 6-inch diameter cylinder centered on the monolith joint. This cylinder is to be filled with melted bitumastic compound during construction. In order to insure the complete filling of the joint, each water-stop is provided with a loop of steam pipe which will serve to melt the contents. This steam heating unit will terminate in the service gallery so that additional bitumastic compound may be pumped into the water-stop at any time and the entire water-stop reformed by heating in case the monoliths separate or settle out of line.

The lower gallery will be located at Elevation 180. This gallery is intended principally for grouting operations and for the drainage both from foundation drains and face drains. All galleries and stairways will be thoroughly ventilated and well lighted.

5-07. BULKHEAD CHAMBERS. - An enclosed space is formed under the deck level of the north bulkhead which will be used for gate repairs and to house the air compressor, miscellaneous equipment, etc. A covered hatchway permits the handling of a gate into or out of this space. A similar enclosed space in the south bulkhead will contain the electrical distribution equipment and the gasoline-electric stand-by unit.

5-08. GASOLINE- ELECTRIC STAND-BY UNIT. - The stand-by generating unit will consist of an alternating current generator, direct-connected to a gasoline engine (see paragraph 8-03). The unit will be mounted on a vibration absorbing base. The engine will be provided with a suitable governor, tachometer, and self-starter. The voltage regulator, meters, and other control and protective equipment will be mounted on a suitable switchboard. Provision will be made for automatic starting of the engine and transfer of the load to the generator, in case of failure of the normal power supply.

5-09. CONSTRUCTION PROGRAM AND REGULATION OF FLOW.

(a) First Stage. - As uninterrupted flow through the existing canal must be maintained, the concrete gate structure will be built in a short cut-off channel. This will lead from the St. Lawrence River to a point just above the existing highway bridge over the present canal. The first stage will be the excavation for and the construction of the spillway, the south bulkhead, the first two monoliths of the north bulkhead, and the training walls. This part of the work can be done in the dry without interfering with or endangering the bank of the present canal. Compacted earth backfill will be placed around the bulkheads up to Elevation 210, that at the north bulkhead being backsloped from the base of the unfinished portion so that the temporary end of the bulkhead is in a small open pit lying between the old and new canals. Suitable material from the excavation will be used for the construction of the south wing dam, and part of the wing dam will be built in this stage to the extend that material from this source is available. The deck over the spillway will be built, the gantry crane erected and the upstream stoplogs furnished, either in this stage or in the first part of the second stage.

(b) Second Stage. - The second stage will include the excavation of the new canal upstream and downstream from the concrete structures, as much as possible being done in the dry. Suitable material from the excavation will be used to continue construction of the south wing dam which will be completed in this stage if sufficient material is available. The last part of the second stage will be the construction of rock and earth fill cofferdams across the old canal. These cofferdams will later form the upstream and downstream toes of the north wing dam which will be built in the fourth stage. All of the water for the power canal will thus be diverted through the new intake structure. From this time until final closure of the Intake Works the flow will be regulated, first, by placing or removing upstream stoplogs and, later, as described in paragraph (e).

(c) Third Stage. - The area between the two cofferdams lying across the old canal will be pumped out, the excavation completed and the two end monoliths of the north bulkhead built. It is evident that the foundation for these two monoliths will, at this stage, be protected on all sides by cofferdams, backfill or natural earth formations.

(d) Fourth Stage. - The north wing dam will be constructed and the south wing dam will be completed if it has not been finished in the second stage.

(e) Fifth Stage. - This is the final stage, which includes installation of the control gates. The canal flow, at about Elevation 201, will continue to pass through the eight diversion openings of the structure until shortly before the closure of Long Sault Dam. At this time, the first two control gates at the south end of the structure will be installed, together with their hoisting and automatic control equipment. In installing each gate, the work area will first be unwatered by placing stoplogs in the upstream and downstream slots. After the gate seat, the conduit liner, and the surrounding concrete have been placed the gate will be lowered, the hoist set, and the downstream and upstream stoplogs removed. Water control in these two openings will thus be taken over by the permanent control gates.

For a period of about three months thereafter, while the Long Sault Dam pool is being raised to Elevation 226, flow regulation will be accomplished by means of the upstream stoplogs in combination with, first, the two control gates previously installed and, later, with these and additional gates. At the start of this period the flow will be no greater than is necessary to maintain the desired water level in the canal, and the float well controls will keep the two gates wide open. As the pool above the Intake Works rises, the discharge into the canal will increase, the water level in the canal will start to rise and the float well controls will begin to close the first control gate. After the pool has reached an elevation high enough to pass the required flow through the six diversion openings plus the second control gate, and continues to rise, the first gate will be entirely closed and the second gate will start to close. Before the second gate is entirely closed, enough stoplogs will be placed in the upstream slots of the six remaining diversion openings to cut down the flow sufficiently so that the automatic controls will again open the two control gates. As the pool continues to rise, this process will be repeated, care being taken to keep the tops of the stoplogs as nearly as possible at the same elevation in all openings. At any time during the period, providing the pool is high enough to maintain the desired level in the canal, additional control gates will be installed, one by one, and placed under automatic control as described for the installation of the first two gates, until flow through all of the eight openings is controlled by the permanent gates. Gates should be installed as soon as possible for the sake of economy, as delay would mean more work in unwatering; but delay would have no bearing on the feasibility of the closure program, as gates may be installed, if necessary, after the pool has reached Elevation 235 or greater.

## SECTION VI - STRUCTURAL DESIGN

6-01. SCOPE. - This section describes the stress analysis procedure adopted, assumptions made, and methods employed to determine the design for the various parts of the structure. Much of the design procedure to be described has not at this time been carried out and it is the intention to describe it here only as a guide to the future complete design of this project.

6-02. DESIGN OF SECTIONS. - The designs of the various sections of this structure are based on simple two-dimensional mechanics, which are sufficiently accurate for a structure of this type and size. The unit stresses are based on the simple formula:

$$p = \frac{P}{A} \pm \frac{Mc}{I}$$

p = unit stress at the limits of the section
p = total vertical force on the section
A = area of the section
M = bending moment acting on the section
c = distance of face from neutral plane
I = Moment of Inertia of section

For results of studies of spillway and bulkhead monoliths, see Section IX.

6-03. PRINCIPAL STRESSES. - It is intended to plot the "principal stress" diagrams for all sections of the structure in order to arrive at a more accurate basis of design for reinforcement in the vicinity of the gallery, adits, and piers. Reference is made to paper 1847, proceedings of the American Society of Civil Engineers, "Determination of Principal Stresses in Buttresses and Gravity Dams," by W. H. Holmes. The detailed application of this method is described in the Analysis of Design Report for the Caddoa Dam.

6-04. SPILLWAY BRIDGE. - No detailed design has been made for the spillway bridge, but sufficient investigation was made to establish the probable maximum size of girders and thickness of slabs. Maximum live loads assumed were:

(a) On slabs, a 22,000 pound gate supported on the slab, causing a loading of 2,200 pounds per foot width, concentrated at midspan; plus impact of 25 percent.

(b) On the crane runway, loading from two two-wheel crane trucks on each rail. Trucks are spaced on 18 foot centers with wheels on 2'9" centers, and the assumed load is 45 kips per wheel, plus impact of 25 percent.

(c) On the highway, standard H20 loading.

(d) On the gate hatch covers, a live load of 250 pounds per square foot.

6-05. EARTH PRESSURES. - The phsical properties of earth fill were assumed as follows:

Dry weight = 110 lb./cu.ft.
Specific gravity = 2.65
Void ratio = 0.5
Angle of internal friction
(Angle of repose) Ø = 33°
Sin Ø = 0.5446

Applying Rankine's well known equation,

$$p = \frac{wh^2}{2}\frac{(1 - \sin \phi)}{(1 + \sin \phi)}$$

the following horizontal pressures were then determined and used:

Dry earth (liquid equivalent) = 32.5 lbs./cu.ft.
Saturated earth and silt = 82.5 lbs./cu.ft.

6-06. DESIGN OF PIERS. - The piers are of comparatively slender proportions. They will be reinforced for all computed stresses. There is no opportunity to employ structural steel framing to any advantage. The piers will be designed to support not only the maximum normal reaction of the stoplogs, ice pressure against the upstream curtain wall, and the balanced and unbalanced reactions from the bridge and gantry crane, but also for twisting loads and hydrostatic loads due to partial stoplog closure. Reinforcing will be carried down into the mass of the dam well below the level of possible tension on the pier monoliths.

6-07. REINFORCING. - It is intended to use reinforcing in all pier and spillway monoliths whereever the computations indicate that tension may occur.

## SECTION VII - WATER CONTROL EQUIPMENT

### 7-01. GENERAL.

(a) Equipment Items. - The principal items of equipment are:

(1) Temporary Upstream Stoplogs
(2) Permanent Upstream Stoplogs
(3) Downstream Stoplogs
(4) Gantry Crane
(5) Control Gates
(6) Hoists

(b) Operation.

(1) After the water is diverted from the present power canal to the partially completed intake structure, and before the Long Sault Dam pool is raised, there will be no need for operation of control equipment. As soon as the pool starts to rise above Elevation 201 it will be necessary to control the flow and it is intended that this will be done by temporary stoplogs in the upstreams slots operated in conjunction with the first two control gates after they are installed (see paragraph 5-09) (e)). Enough of these stoplogs, each about 6'1-1/2" high, will be provided to close six of the eight gate openings to Elevation 226. The stoplogs will be handled by the permanent gantry crane which will be installed on the deck at Elevation 255.

(2) Permanent stoplogs will be required for unwatering any openings for maintenance or repair work below pool level. These stoplogs, in sections about 5'10" high, will be used also for unwatering the gate openings in order to pour the concrete around the conduit liner and control gate seats and to set the guides and gates. Enough sections will be provided to close two gate openings to Elevation 235, which will permit work to be done in setting the control gate structures in two openings at once. For maintenance use it will be possible with this number of stoplogs to close one opening when headwater is at the maximum level, Elevation 249. These stoplogs will also be handled by the gantry crane. The upstream stoplog slots will be steel lined and will suitable for installation of trash racks if it is later found that they are necessary.

(3) Downstream stoplogs of timber will be provided at the lower end of the stilling basin for the purpose of unwatering the conduit in conjunction with the upstream stoplogs. They will be handled by a small electric hoist on a monorail supported by short columns on the piers just downstream from the service bridge at Elevation 210. These stoplogs may also be used for varying the height of the submerged weir at the lower end of the stilling pool. Enough stoplogs will be supplied to close two-gate openings to about Elevation 204 which is about three feet above the controlled canal level.

(4) The gantry crane will be used primarily to handle the upstream stoplogs and to handle the control gates when removal from the slot is necessary for maintenance or repairs. In order to remove a gate it will be necessary to first remove with the crane the fixed hoist and the slot covers over the gate opening. After hoisting the gate above the deck level the crane may transport it along the runway to the repair bay. If, at any time in the future, trash racks are installed, raking and handling will be done by the crane.

(5) The control gates will be operated by individual hoists equipped with automatic controls actuated by float wells in the canal. When the water surface in the canal drops or rises gates will open or close successively to maintain the required flow (see paragraph 5-02). In order to remove a gate from the slot, the gate will be raised by its hoists to a platform at Elevation 244 and dogged. The hoist sheave block will then be disconnected from the gate and the gantry crane will remove the hoist and slot covers. The crane hook will then be connected to the gate and the gate removed.

## 7-02. CONTROL GATES.

(a) Choice of Type. - The tractor type with sloping seal surface was selected for the automatically controlled service gates for the following reasons:

(1) This type is less liable to chatter at partial opening, which is the prevailing operating condition.

(2) The sloping seal surface permits water to flow around the top seal as soon as the gate starts to rise, partially relieving the low pressure area at the top of the conduit just below the seal.

(3) The gate is self-closing.

(4) No water-tight bearing enclosures are required.

(5) Wheel bearing friction and seal friction are eliminated.

(6) Flexible seals are not required.

(7) No greasing is necessary.

(b) Loads and Unit Stresses. - Two loading conditions were considered:

(1) Headwater at Elevation 242 with no tailwater. This would be the condition existing with the conduit unwatered and the pool at normal operating level.

(2) Headwater at Elevation 249 with tailwater at Elevation 202. This would be the condition existing with the pool and the water in the canal both at assumed maximum level.

The unit stresses allowed for structural steel correspond to the 18,000 pound per square inch base; but the thickness of all members are increased 1/16" over the design thickness to allow for corrosion. The maximum load in pounds on one roller is 500 LD, "L" being the length of roller and "D" the diameter.

A minimum material thickness of 3/8", except for fillers, was adopted.

(c) Structural Design.

(1) The gates are of structural carbon steel plates and rolled sections, entirely shop fabricated. Arc-welding is used throughout for permanent connections. The roller trains run on steel castings bolted to the end plates. When the gate is seated its weight is taken into the sill by pins near each end post. These pins are threaded to permit adjustment to the sloping seal surface in order to prevent either wedging or loose sealing. The mating parts for the threaded pins are bolted to the bottom of the gate by turned bolts in shear.

The skin plate is welded to the upstream flanges of the horizontal girders. The bottom of the gate is covered with removable plates, sloping downstream to present as smooth a surface as possible to the flow of water and to minimize suction at small gate openings.

The hoisting connection is at the center of the top of the gate and consists of two stiffened plates welded to the gate body.

The lower sheave block of the hoist fits between the two plates and is fastened by means of a pin through the sleeve carrying the sheaves and through bored holes in the plates.

A dogging seat is provided near the top of each roller train casting.

(2) Below Elevation 206 the gate guides are embedded in the concrete and the rollers bear on stainless steel plates bolted to the guides with countersunk head bronze screws. Between Elevation 206 and the dogging platform at Elevation 244 the guides consists of steel plate and rolled sections enclosing the roller trains and are supported by structural steel bracing. The dogging platform is floored with steel grating carried by rolled steel beams. An inclined type dog engages the seat on the roller train casting at each side of the gate.

(d) Water Seal. - The water seal is formed by close contact between bronze bars on the gate and on each edge of the sloping face of the conduit entrance.

(e) Protection Against Ice. - Since the conduit opening is forty feet below minimum pool level, no ice trouble is anticipated at the gate. See also paragraph 5-02.

### 7-03. STOPLOGS.

(a) Permanent Upstream Stoplogs. - Each stoplog consists of three horizontal steel beams framed into end posts and with a steel skin plate riveted to the upstream flanges. The side seals consist of "J" type rubber seals and the horizontal seals between sections are flat rubber strips. Preliminary studies showed that little would be saved, considering minimum material requirements and the advantages of duplication, in designing the stoplogs in sections to carry decreasing loads from the maximum load at the bottom, hence all sections are identical. Since there are approximately 44 sections, all alike, riveted construction is used except for minor details. The sections will be handled by means of a lifting beam hung from the crane hook by a chain sling. The beam contains hooks which will engage or disengage the stoplogs automatically. It is intended that the stoplogs will be stored off the structure after construction is completed and trucked within reach of the crane when needed.

(b) Temporary Upstream Stoplogs. - Each temporary stoplog consists of three horizontal steel beams framed into end posts and with timber sheating bolted to the upstream flanges. Since it is not necessary to seal tightly, the side seals are of belting and the horizontal seal between sections is formed by contact between timbers. Like the permanent stoplogs, all sections are identical for duplication in manufacture and for placing in the slots without the necessity for selection. Riveted construction is used in framing. Lifting connections are designed for use of the lifting beam described in 7-03 (a).

(c) Downstream Stoplogs. - The low maximum head permits use of timber for the downstream stoplogs. They are of 14"x14" nominal size, dressed on four sides, and will run in unlined slots in the piers.

### 7-04. HOISTS.

(a) Choice of Type. - Because of the distance from the deck level to the gates, because the gates are self-closing, and for convenience in removing a gate from its slot when necessary, a cable hoist was selected in preference to a screw hoist.

(b) Capacity and Speed. - The nominal capacity of each hoist is 35 tons, which is about 7 tons in excess of the maximum computed lifting load and should be ample to take care of impact and suction. The normal hoisting speed is 2 feet per minutes.

(c) Design. - The allowable unit stresses in structural parts conform to the 18,000 pound per square inch base, reduced proportionately in the ratio of 16,000 to 18,000. A minimum factor of safety of 5 was required for mechanical parts. An eight part, double-reeved line is used and the lower sheave block is connected directly to the lifting plates on the gate. The drum is operated by a squirrel cage motor through a worm gear reducing unit and a train of spur gears. A slack cable limit switch is provided to protect gate and hoist when the gate is being lowered. A weather-tight sheet steel cover completely encloses each hoist and is shaped to present a smooth appearance.

## 7-05. GANTRY CRANE.

(a) Choice of Type. - Preliminary cost comparisons showed that the outdoor construction, with the traveling gantry and individual covers for the hoists, is more economical than an enclosure with a powerhouse type crane. If the powerhouse type crane were used, it would be necessary to provide separate measns of operation for the upstream stoplogs.

(b) Capacity and Speeds. - The capacity was set at 35 tons, since it is possible that the crane may be required to operate a gate under load. Hoist speed is eight feet per minute, trolley travel 30 feet per minute and gantry travel 75 feet per minute.

(c) Design. - The allowable unit stresses in the structural and mechanical parts are the same as for the hoist (see 7-04 (c)). Since the crane is probably the most conspicuous part of the entire structure it is designed to present as pleasing an appearance as possible, with girders and portal legs of box sections and with sheet steel machinery enclosures. Due to the long travel of the hoist block, the trolley is of the double drum type with eight part double reeving. The block is equipped with a single swivel hook for engaging the chain slings used to operate the stoplogs and for miscellaneous hoisting service. Gantry drive power is provided by two motors, one in each of the two trucks at one end of the crane. The motors and drive machinery are concealed by the truck housing. Trolley and gantry drive motors and hoist motors are of the wound rotor type. Power take-off will be by flexible cable on a crane-mounted cable reel and equipped to plug in at power outlets near the downstream rail.

## SECTION VIII - ELECTRICAL DESIGN

8-01. GENERAL. - Electric power will be required to operate the gantry crane, the eight gate hoists, the air compressor for the bubbler system, sump pumps, lights, convenience outlets, and power equipment in the gate repair bay. The utilization voltage will be 460 volts, three phase, 60 cycles, for all loads except lights and convenience outlets, which will take 115 volts, single phase. A bank of three 50 kva single transformers will be provided to step the incoming power down to 460 volts, three phase. Three 5 kva, 460-230/115 volt, single phase transformers will supply power to the 115 volt, 3-wire circuits for lights and convenience outlets. They will make up a nearly balanced three phase load on the main transformer bank and on the standby generator. A gasoline engine driven, 156 kva, standby generating unit will provide emergency power for operation of the hoists, lights, and gantry crane. The main tranformers, the standby generating unit and the main switchboard will be located in an electrical bay in the south bulkhead. Lighting transformers will be placed to provide short secondary leads. The air compressor will be located in the gate repair bay in the north bulkhead.

8-02. POWER DISTRIBUTION.- Radial secondary feeders from the switchboard will provide for distribution at 460volts. Four feeders, each consisting of three No. 40 AWG varnished cambric insulated copper conductors, will supply power to the eight gate hoists, two hoists per feeder. One feeder, consisting of three No. 8 varnished cambric insulated copper conductors will supply three phase power to the gate repair bay in the north bulkhead, and to four plug receptacles, accessible from the deck, from which power will be taken through a portable cable to the gantry crane. Distribution is shown schematically on Plate VIII-1 ~~inch~~ which is included in this Section.

8-03. GASOLINE-ELECTRIC STANDBY UNIT.- A 156 kva, 80% power factor, 3 phase, a.c. generator, driven by a 200 HP gasoline engine will provide power for emergency operation of the hoists, lights, and gantry crane in case of a power failure in the regular service. This standby unit will start up automatically when the power fails. A short time delay will be introduced to prevent starting up on momentary outages. An automatic transfer switch will disconnect the regular service and connect in the generator after the generator voltage has come up to normal. When the regular service voltage comes back to normal, the automatic transfer switch will throw the load back on the regular service and the standby unit will be shut down. The generator will be provided with a direct connected exciter and an automatic voltage regulator.

8-04. CONTROL. - All eight gate hoists will be automatically controlled by float wells in the Massena Canal. Hoist motors will be high slip squirrel cage induction motors. Each will be provided with a reversing line starter, upper and lower limit switches, slack cable limit switch, and thrustor ~~or solenoid~~ brakes. Local push button control will take precedence over the automatic float well control.

## SECTION IX - STABILITY

### 9-01. LOADING CONDITIONS.

(a) Headwater. - The Massena Canal Intake Works will be subjected to approximately the same headwater loading conditions as Long Sault Dam. Therefore, the concrete structure has been investigated for two loading conditions:

(1) Headwater Elevation 249.0 with no ice pressure.

(2) Headwater Elevation 245.0 plus ice pressure of 10,000 pounds per lineal foot acting at Elevation 244.0 (see Section II).

(b) Tailwater. - It is assumed that at some future date, after the completion of the St. Lawrence project, use of the Massena Canal will be discontinued. hence these stability studies have assumed a tailwater Elevation of 170.0, the elevation of the bottom of the canal downstream from the Intake Works.

(c) Uplift. - Uplift pressure was assumed as, first, full headwater at the upstream toe decreasing to full tailwater at the downstream toe, applied over two-thirds of the base area; and, second, tailwater plus 50 percent of the difference between headwater and tailwater at the upstream toe decreasing to tailwater at the downstream toe, applied over the entire base area. The first condition was found to be more severe at all pool levels.

(d) Foundation Elevation, Width; Effective Downwater. - Present knowledge of underlying rock indicates that the foundation, keyed about 5 feet into the rock, will vary in elevation between 155 and 163. Hydraulic requirements had already fixed the spillway base width at 105'9". This width was studied at Elevations 155 and 163 and found stable, even under a further, very severe condition. The headwater was assumed held by stoplogs in the slot at the upstream face of the dam. (This is more severe than holding the water with a control gate in the slot downstream because the resisting-moment effect of downwater, present in the latter case, is absent in the former.) Sufficient stoplogs will be provided to shut off only one bay in this manner. Therefore, the assumed loading condition could be attained only if the spillway were poured in 32-foot monoliths. It is intended that the entire spillway will be built in only four monoliths, each two bays long. Thus any one bay, loaded as assumed in the stability studies, would if necessary be restrained from overturning by the adjacent bay loaded less severely.

### 9-02. OUTLET STUDIES: CONCLUSIONS.

(a) Unit Stresses. - Plates IX-1 and 2 show the results of these outlet investigations. It will be noted that bearing and shear stresses are low. (Maximums are 60 and 18 pounds per square inch.) Bending stresses in the floor slab, as elsewhere throughout the spillway, will be taken by reinforcing to be detailed later.

(b) Friction Coefficient. - It may be noted also (Plate IX-1) that the value of H/V goes as high as 0.77. If is felt that this value is not excessive because, with the structure well keyed into the rock, slip cannot occur without failure of material. Therefore, the combined shear-friction value of the material will govern, rather than the recommended value of 0.7 for friction alone on a rough surface. The admission of headwater into the control gate in its regular location, with consequent increase in downward force, brings H/V to a value well below 0.7.

9-03. BULKHEAD STUDIES: CONCLUSIONS. - The bulkhead monolith nearest the spillway was analyzed under the same headwater and tailwater conditions as was the spillway. The beneficial effect of earth pressure was disregarded. Here, again, stresses were low and design was fixed by avoiding tension at the faces.

Results of these bulkhead studies are shown on Plates IX-3 and 4. Other bulkhead monoliths, farther from the spillway, are similar to the one studied and are even more firmly restrained by passive earth pressure

## SECTION X - INVESTIGATIONS OF OVERBURDEN AND BEDROCK FOR FOUNDATIONS AND EXCAVATIONS AND MATERIALS FOR EMBANKMENTS, COFFERDAMS, AND CONCRETE AGGREGATES

10-01. FIELD EXPLORATION OF OVERBURDEN AND BEDROCK PRIOR TO OCTOBER, 1940. - Prior to October, 1940, the Governments of Canada and the United States made investigations in the vicinity of the Massena Canal Intake Works for the purpose of determining the overburden and rock conditions. The field explorations were of a preliminary nature, the most detailed explorations being made in 1923 when 3 holes were drilled near the entrance of the present power canal. The logs of these 3 holes are on file in the District Office. The location of all drilling prior to October, 1940 is shown on Plate X-1.

### 10-02. FIELD EXPLORATION OF OVERBURDEN AND BEDROCK SINCE OCTOBER, 1940.

(a) General. - Overburden and bedrock exploration at the diversion canal, spillway, and wing dams since October, 1940, were conducted by the U. S. Corps of Engineers for the purpose of obtaining information for designs, and included geological reconnaissance, drilling in overburden and rock, and the determination of bedrock elevations by the seismic method. The location and extent of the exploration at the sites are shown on Plate X-1. Drawing LW-1-1/3 of the contract drawings shows the location of all exploration except seismic. Complete reports of the drill holes and notes and computations of the seismic investigations are on file in the District Office. Records of the drilling exploration are shown on Drawing LW-1-1/4 of the contract drawings. All soil samples and bedrock cores are stored in the District Soils Laboratory.

(b) Drill Holes. - Holes of two sizes were drilled in the vicinity of the diversion canal, spillway and wing dam sites. Holes for the purpose of determining both overburden and bedrock conditions were drilled with diamond core drilling equipment using 3-1/2-inch casing in the overburden and 2-1/8-inch bit to obtain bedrock cores. Holes drilled specifically for overburden investigation have been drilled using 2-1/2-inch casing. The overburden was dry sampled using either a 2-inch or 1-1/2-inch sampling tube, depending on the size of casing being used. Dry samples were taken at approximately 5-foot intervals or at changes in material and wash boring between samples were permitted. A total of 9 holes was drilled at the sites with a total footage of 452.2 feet in overburden and 60.9 feet in rock.

(c) Seismic Investigations.

(1) Seismic investigations were conducted in the vicinity of the spillway and diversion canal to determine the location of bedrock prior to drilling and to supplement the drill hole information. The work was done under the direction of A. E. Wood, Associate Geologist of the Binghamton District and E. R. Shepard, Senior Physicist, Office of the Chief of Engineers. The method developed by Mr. Shepard was used for the investigations. (See article entitled "The Seismic Method of Exploration Applied to Construction Projects" by E. R. Shepard, the Military Engineer, September - October, 1939.)

(2) A total of 16 lines was fired at the site. Because of the presence of deep and uneven spoil from the excavation of the present power canal the conditions at this location were very unfavorable for seismic tests. Of the 16 lines fired only 5 were considered to be reliable

and the positions of only these 5 lines are shown on Plate X-1. A detailed report of the seismic investigations conducted for the St. Lawrence River Project will be placed on file in the Distric Office.

10-03. EXPLORATION OF MATERIALS FOR THE EMBANKMENTS, COFFERDAMS AND CONCRETE AGGREGATES.

(a) Earth and Rock Fill. - The exploration described in paragraph 10-02 for the overburden and bedrock served to determine the suitability of the spillway and canal excavation for earth and rock fill materials for backfill, wing dams, and cofferdams. No specific exploration was made for the location of earth fill borrow areas because, from the general geology of the vicinity and exposures along the power canal, it is known that suitable material is available. The borrow area which contains suitable materials is located because of its respective position to the structures and is shown on Drawing LW-1-1/1 of the contract drawings. This area is considerably larger than required, and it is planned to do exploration within the area to determine which sections contain the more suitable materials. Some rock is available from the spillway excavation. However, this quantity will not be sufficient to meet requirements. and rock will have to be borrowed to complete construction. During exploration for concrete aggregates for the St. Lawrence River Project, all rock outcrops and probable quarry sites which were economically located were investigated and the report of these investigations is on file in the District Office.

(b) Sand and Gravel Filter. - Exploration was conducted to locate deposits of suitable material for the sand and gravel filters and backing of the wing dams. It is believed that all deposits within a radius of 15 miles of the site have been located. The most feasible deposits were sampled and tested to determine the gradation of the material. One small superficial deposit is located within the borrow area shown on Drawing LW-1-1/1 of the contract drawings. A complete report of these investigations will be placed on file at the District Office.

(c) Concrete Aggregates. - Exploration to locate suitable sources of concrete aggregates is being conducted. It is planned that the exploration will be completed so that information will be available prior to letting of the contract. Many deposits of sand and gravel within a radius of 25 miles of the site have been sampled and representative samples have been tested in the Central Concrete Laboratory, West Point, New York, to determine the suitability of the materials for concrete aggregates. All rock quarries in the vicinity have been sampled and the materials tested in the Central Concrete Laboratory. Studies are being made to determine if suitable stone sand can be produced from local rock for fine concrete aggregate. Natural deposits of sand or sand and gravel are being explored which are outside of a 25-mile radius and are near a railroad or near the St. Lawrence River. Complete report of all investigations will be placed on file at the District Office.

10-04. LABORATORY TESTS ON SOILS. - An extensive program of soil testing was not made. The type of overburden materials in the excavation areas, the foundation areas of the designed portion of the wing dams, and the materials available for embankment construction are such that an extensive testing program has not been conducted. A more extensive program will have to be completed before the remaining section of the south wing dam can be designed. All soil samples were classified using the M.I.T. scale of classification and recorded in a final report of each hole. The grain size distributions of a sufficient number of samples were determined by the usual sieve and hydrometer methods to serve as a guide in the classification of all samples. General geological descriptions of the overburden at each drill hole were prepared after studying the laboratory classifications and the field logs. Moisture contents on 13 clay samples from holes D-1244, D-2023, D-2055, and D-2056 were determined. No moisture content determinations were deemed necessary for the other materials. No specific gravity, natural density determinations, shear, consolidation or perability tests were made.

10-05. LABORATORY TEST ON ROCK. - The rock cores obtained from drill holes were classified by a geologist. The condition of the bedrock was determined by an interpretation of the field logs and visual examination of the cores. Detailed and general classifications are recorded in the final report of each drill hole. The general classifications are shown on Drawing LW-1-1/4 of the contract drawings.

10-06. RECOMMENDED FUTURE INVESTIGATIONS.

(a) Field Exploration. - Prior to completing the design of the south wing dam (see Drawing LW-1-1/1 of the contract drawings), the extent and depth of the soft gray clay in the foundation should be determined. It is recommended that sufficient exploration be conducted to thoroughly trace the extent of the clay and also that one or more 6-inch holes be drilled to obtain undisturbed samples of the clay for laboratory tests. Also, it is believed advisable to drill one hole at the spillway site to a sufficient depth in rock to assure that no large cavities or gypsum beds exist at an elevation where they could cause difficulty. This hole should be pressure tested. Plans and specifications for the Massena Canal Intake Works provide for the systematic exploration and pressure testing of the areas under the concrete structure and the higher portions of the earth wing dams. A grout curtain will be formed along these portions of the structure and other areas will be explored and grouted if deemed necessary. The borrow areas ahould be explored with test pits and drill holes to assure the selection of the most suitable materials.

(b) Laboratory Investigations. - The undisturbed samples of clay obtained from the proposed 6-inch drill hole should be tested to determine the shearing strength and consolidation characteristics of the material as this information must be obtained before the design of the south wing dam can be completed. All necessary routine tests should be made on all foundation and borrow materials explored in the future. Tests should be made during construction to determine the relation between water content and unit weight to be obtained when compacting the materials in the embankment. No laboratory tests on the bedrock are recommended

## SECTION XI - DESIGN OF EMBANKMENTS AND FOUNDATION FOR THE SPILLWAY

11-01. GENERAL. - The design of the embankments, the canal slopes and the spillway foundation involved a study of the foundation conditions and characteristics, a study of the characteristics of the available embankment materials, the choice of sections which will utilize economically the available embankment materials and will be safe under any conditions. The method and the extent of the investigations to determine the characteristics of the foundation and embankment materials have been described in Section X. As sufficient investigations have not been made regarding the extent and characteristics of the clay deposit which underlies the major portion of the south wing dam, the embankment over this area has not been designed pending the future investigations recommended in Section X. Included herein is a description of the results of those investigations completed which are pertinent to the design and a discussion of the choice, economy, and design of the embankments and a discussion of the foundation treatment of the spillway.

### 11-02. GEOLOGICAL FEATURES AND CHARACTERISTICS OF FOUNDATION MATERIALS.

(a) Description of Site. - The Massena Canal Intake Works is located on the United States shore of the St. Lawrence River in the vicinity of the present Massena power canal. The spillway is located in the diversion canal between the west bank of the power canal and the St. Lawrence River on the lower flank of the glacial till ridge which rises from the river. The north wing dam extends from the north side of the spillway structure across the present power canal and terminates on the till ridge on the east side of the power canal. The south wing dam extends from the south side of the spillway structure upstream across a flat sand and clay plain.

(b) Bedrock.

(1) The bedrock at the site, as shown by cores recovered from drilling, is dolomite interbedded with occasional thin beds of shale. Considerable calcite was found throughout the cores and a few stringers of gypsum were observed in one core. Shale beds varied from 1/2 inch to 8 inches in thickness. The general rock classifications at each drill hole are shown on Drawing LW-1-1/4 of the contract drawings. More detailed classifications are given in the reports for each drill hole on file in the District Office.

(2) The rock is horizontally bedded and generally sound and hard. However, some of the rock did appear to be slightly weathered. The bedrock is intersected by several joint systems apparently haphazard in pattern. A study of the drill hole field logs and visual examination of the rock cores show that no large cavities or open fissures exist in the rock to the depth explored. However, holes were not drilled beyond 20 feet into bedrock.

(3) Bedrock contours drawn from the information obtained from drilling and seismic investigations are shown on Plate X-1. The contours have been extended somewhat to show the general trend of the rock surface. The bedrock contours in the immediate vicinity of the spillway and diversion canal are considered sufficiently accurate for design purposes.

(c) Overburden.

(1) Spillway and Diversion Canal. - In the diversion canal between the spillway and the St. Lawrence River the overburden con-

sists of 7 to 20 feet of artificial fill overlying glacial till. Between the spillway and the power canal up to 10 feet of artificial fill overlies approximately 10 feet of marine silts and clays which overlie glacial till.

(2) North Wing Dam. - The overburden between th spillway and the power canal apparently consists of fairly loose to compact glacial till which may have a few feet of spoil above it. The material in the bottom of the present power canal is believed to be glacial till but between the center and the east bank of the canal the bottom may be clay. East of the power canal to the 240 contour, 0 to 10 feet of artificial fill, overlies 0 to 20 feet of clay. Beyond the 240 contour a till hill rises. Beach deposits of slightly silty sand and gravel may blanket the till hill above Elevation 240.

(3) South Wing Dam. - From the spillway to a point approximately 600 feet along the south wing dam, the overburden consists of a fairly compact to compact glacial till. From this point on, the wing dam is on a sand and clay plain where the soft gray clay apparently reaches depths of 50 feet or greater and is capped with from 3 to 10 feet of fine uniform sand and brown sandy clay.

(4) Overburden Characteristics. - The glacial tills existing at the Massena Canal Intake Works are variable but consist mainly of silty, gravelly sands and sandy, gravelly silts. In general the top 10 feet of till is loose to fairly compact below which the material is compact. It is estimated that the natural density of the material is approximately 140 lbs. per cu. ft., that the coefficient of permeability varies between 0.00001 and 0.0000001 cm. per sec., and that in nature the angle of internal friction is greater than 30 degrees. The brown sandy clay and the gray clay have average water contents, based on dry weight, of 35 and 55 percent respectively. The shearing strength of the clays will have to be determined. The artificial fill that is found at the site may be so variable that a reasonable estimate of the characteristics of this material cannot be made. Typical grain size curves of the materials are shown on Plate XI-1.

## 11-03. AVAILABILITY AND CHARACTERISTICS OF EMBANKMENT MATERIALS.

(a) General. - The material for the embankments will be obtained from the spillway and diversion canal excavation, from the borrow areas shown on Drawing LW-1-1/1 of the contract drawings and from gravel and rock sources selected by the contractor. The borrow areas for the earth fill section contain the most economical materials in the vicinity which are suitable for a safe design. The following paragraphs describe the characteristics of the deposits and materials to be utilized, as determined by the investigations described in Section X which influence the design of the wing dams.

(b) Earth Fill. - The materials for backfill and earth fill sections of the wing dams will be obtained from the spillway and canal excavation and from borrow areas. The material will be mainly glacial till and in nature has the characteristics described in paragraph 11-02. The spillway and diversion canal excavation will be used in the construction of the south wing dam. Material for the north wing dam will be obtained from the borrow area east of the present power canal. Prior to construction the borrow area will be explored to determine the location of the more suitable materials. To permit such selection the quantity of material within the area shown is in excess of that required. The material within the area is a compact silty sand and gravel with scattered boulders and numerous cobbles, the same as the glacial till in the excavation areas. The material for earth fill is very well graded and it is estimated that when compacted it will have a wet weight greater than 125 lbs. per cu. ft., a permeability of less than 0.00001 and an angle of internal friction of at least 30 degrees.

(c) Sand and Gravel. - Sand and gravel for the downstream filter materials for the wing dams and for backing under the riprap will be obtained from sandy gravel deposits as selected by the contractor. There are within 15 miles of the site small superficial deposits of sand and gravel containing material which is believed to be suitable. A limited amount of material may be obtained from the small deposit referred to in paragraph 10-03(b).

(d) Rock Fill and Riprap. - Part of the material for the cofferdams, rock toe fillet and riprap (see specifications) for the wing dams will be obtained from rock excavation and by removing stones from earth embankment materials. Additional rock required will have to be borrowed.

11-04. TREATMENT OF SPILLWAY FOUNDATION. - The foundation for the spillway and bulkheads will be sound rock. All loose, weathered or badly fractured rock will be excavated to produce a suitable foundation. The bedrock will be thoroughly grouted as shown on the contract drawings. Shale beds will be excavated to found the base of the structure on beds of other rocks.

11-05. COFFERDAMS. - In order to construct in the dry that section of the north wing dam to be built across the present power canal it is necessary to build two cofferdams. These cofferdams consist mainly of dumped rock fill with an adequate dumped earth section on the pool side to reduce seepage to a negligible amount. Typical sections for the cofferdams are shown on Drawing LW-1-20/1 of the contract drawings. Both the cofferdams are finally incorporated in the final embankment section across the power canal.

11-06. WING DAM SECTIONS.

(a) General. - As the design progressed to its final stage, the sections shown on Drawing LW-1-20/1 of the contract drawings were developed. Initial sections were the same as those shown except for the riprap and filter details. The section of the north wing dam on the east bank of the present power canal has been designed to float on the clay in that area. However, any clay beneath the north wing dam in the present power canal will be removed to insure a stable foundation. Only that section of the south wing dam which is founded on a firm foundation has been designed. The section over the deep clay area will be designed later to float on the clay. Before this design can be completed the future investigations recommended in Section X shoud be completed. The essential features of the wing dam embankments now designed will be described in following paragraphs.

(b) Impervious Features. - The wing dams will contain earth fill sections of material having a small coefficient of permeability. The central section of the earth fill will be more heavily compacted with a sheeps-foot roller than will the outer sections, and, therefore, will be slightly more impervious than they. The compacted earth fill will extend a few feet into the foundation overburden to provide a cut-off in the upper overburden materials except in the section of north wing dam which extends across the present power canal. In this area all undesirable material will be removed from the foundation and the cut-off trench will not be necessary. Compacted earth fill will encase the bulkheads.

(c) Drainage Features. - To control the seepage through the embankment of the north wing dam a 3-foot layer of filter material protected by riprap is provided on the downstream slope of the wing dam where the section is less than 30 feet high. Where the section is greater than 30 feet in height a 10-foot layer of filter material is provided on the downstream slope. In either case the maximum elevation of the filter layer is 240. The seepage problem for the north wing dam is mainly one of embankment seepage and not foundation seepage. As the only adequate protection against seepage for that section of the north wing dam across the present power canal was downstream slope protection, it was decided to use that method of seepage control throughout the north wing dam in order to have the filters function as one unit. Seepage control incorporated in the designed section of the south wing dam consists of a 3-foot filter blanket provided under the downstream section. As it was necessary to provide for both foundation and embankment control, this method of design was more desirable.

(d) Slope Protection. - The upstream slopes of the designed embankments will be protected against erosion from wave action and ice action by heavy riprap underlain by small rocks and sandy gravel. The downstream slopes above the rock fillet will be protected by light riprap or by seeding.

11-07. BACKFILL. - Backfill around the bulkheads will be compacted earth fill. The material will be obtained from the spillway or canal excavation or from the borrow area. The slopes of backfill around the buldheads will be protected by riprap or seeding, the same as the slopes of the adjoining wing dams.

11-08. ANALYSIS OF EMBANKMENT SECTIONS. - No mathematical analyses have been made for the embankment sections of the north wing dam and that section of the south wing dam which has been designed. Such analyses are believed to be unnecessary. Based on experience with material and foundation conditions, it is believed that the sections have safety for stability and that the quantity of seepage will be very small. Sufficient freeboard has been provided to compensate for any settlement which might occur. Mathematical analyses must be made prior to design for that section of the south wing dam which extends over the deep clay area.

11-09. ANALYSIS OF CANAL SLOPES. - No mathematical analyses have been made to determine the excavation slopes in the diversion canal required for safety against major slides. A study has been made of the soil conditions with particular attention being given to the depth of clay. It is believed that throughout the diversion canal a slope of 1 on 2 will be amply safe against major slides. In some sections very minor slides may occur due to unusual soil conditions. Where these conditions exist, it is believed that the slope that can be constructed will be stable after construction.

11-10. ECONOMY OF CONSTRUCTION. - The embankments will be composed of suitable earth and rock materials from the spillway and diversion canal excavations and from borrow areas. Provisions have been made to utilize all stone and boulders from the earth fill materials. The quantity of sand

and gravel filter material and the quantity of riprap have been kept to the minimum believed feasible in the design necessary to fulfill all design criteria. The program of construction has been organized so that all earth materials from the canal and spillway excavation will be used in the south wing dam and the earth materials necessary for the north wing dam will be obtained from the borrow area. This program results in the least haul distance and eliminates the transportation of materials over the existing bridge across the power canal.

11-11. FUTURE DESIGN. - After the recommended future foundation exploration for the south wing dam has been completed and the stress-strain characteristics of the soft gray clay determined, the remainder of the south wing dam can be adequately designed. It is believed that a sufficient quantity of material is available for this section of the wing dam from the spill way and canal excavation. However, if necessary, additional material may be obtained from the borrow area. In the design of the section consideration must be given to the continuation as Richard's Landing Dike and the necessary drainage on the land side.

11-12. BASIS FOR ESTIMATES. - Estimates of yardages for the portions of the wing dams designed are based on the sections shown in the contract drawings. The estimates of the portion of the south wing dam which is not designed are based on the following assumptions:

1. All earth material from excavation will be used.
2. Top width will be 35 feet and the slopes will be 1 on 10.
3. The central part of the embankment will be Class II material averaging 40 feet in width.
4. All other embankment fill will be Class III material.
5. No filter material or sand and gravel backing will be required.
6. Two feet of Class "B" riprap will be required on a 1 on 10 slope.
7. A strip approximately 55 feet wide will be stripped under the Class II material.
8. A foundation cut-off trench averaging 3 cu. yds. per ft. of length will be required.

## SECTION XII - COFFERDAMS AND DIVERSION

### 12-01. ORDER OF WORK.

(a) First Stage. - The first stage will be the excavation for and the construction of the spillway, the south bulkhead, and the first two monoliths of the north bulkhead, and the training walls. In the spillway, the concrete around the gates and the discharge conduit downstream from the gates, as shown by the construction joints on the drawings, will be omitted in the first stage in order that the openings, thus left temporarily larger than they will finally be, may be used in subsequent diversion. Compacted earth fill to be placed during the first stage will include the backfill to Elevation 210 around the north bulkhead and in back of the north training walls, all the backfill at the south end of the structure, and part of the south wing dam to the extent that suitable material is available from the excavation for the concrete structures.

(b) Second Stage. - The second stage will include the excavation of the new canal upstream and downstream from the concrete structures, as much as possible being done in the dry. Suitable material from the excavation is to be used in the construction of the south wing dam. The last part of the second stage will be the construction of rock and earth fill cofferdams across the old canal. All the water for the power canal will thus be diverted through the new intake structure, and the cofferdams will later form the toes of the north wing dam slopes across the present channel.

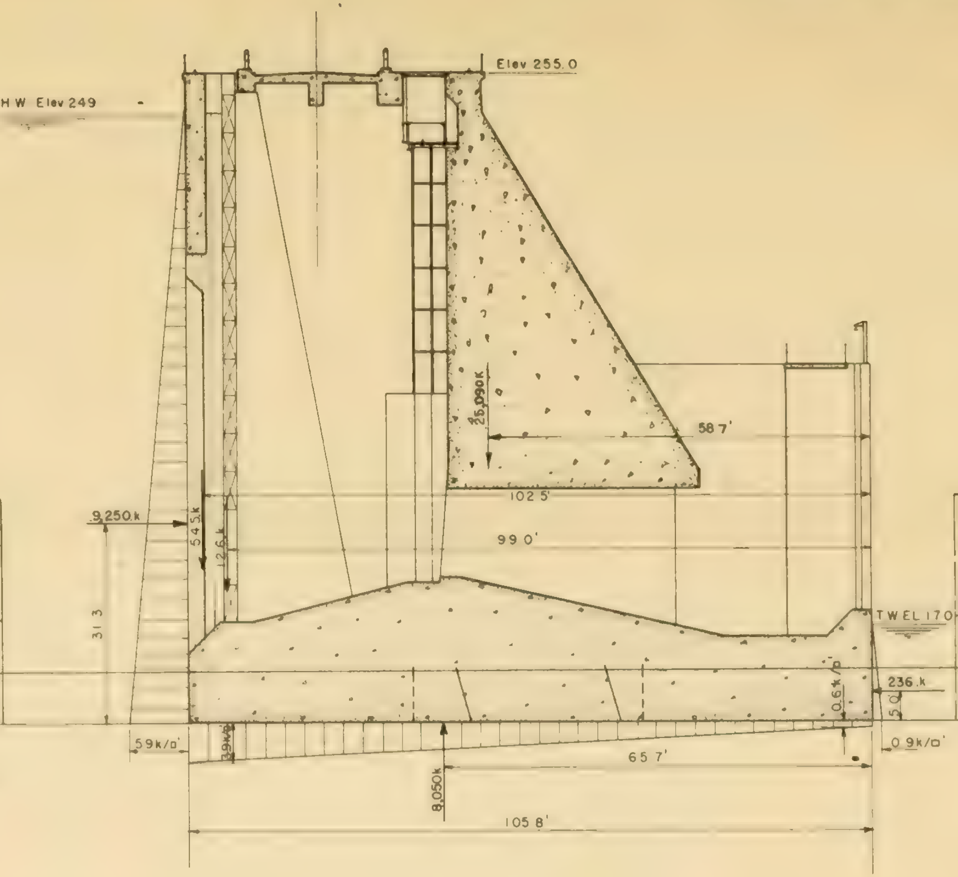
(c) Third Stage. - The third stage will be the excavation for and completion of the remainder of the north bulkhead.

(d) Fourth Stage. - The fourth stage will be the construction of the north wing dam, complete, and completion of the south wing dam if not previously completed. (See paragraph (b))

(e) Fifth Stage. - When the water in the St. Lawrence River is raised behind Long Sault Dam and the powerhouse, sufficiently to pass 25,000 second-feet through fewer than eight bays of the intake, the concrete discharge conduits of the intake are to be built and the vertical lift gates installed. For this purpose the bays will be closed one at a time by stoplogs upstream and downstream, and the remaining seven openings used for discharging the water into the power canal.

(f) Regulation of Flow. - From the closure of the old canal in the second stage to the completion of the fourth stage the contracter will be required to regulate the flow of water through the intake spillway by installing or removing stoplogs so as to maintain the proper level in the power canal, as directed by the contracting officer. During the fifth stage and until completion of the job, the contractor shall regulate the flow by the gates where they have been installed or by stoplogs where the gates have not been installed, as directed by the contracting officer.

LOADING CONDITIONS:
H. W. ELEV. 249.0
T. W ELEV. 170.0
NO ICE
ASSUMED UPLIFT: $\frac{2}{3}$ HEAD



| CONDITION OF RESERVOIR | | | |
|---|---|---|---|
| Full | Empty | | |
| $S_v$ | $S_v$ | Position of Resultant | |
| Lbs. Per Sq. In. | | | Elev. |
| 37 | 58 | 10.4 | 163 |
| 38. | 66. | 11.6 | 155 |

STABILITY FACTORS
Stresses At Upstream Face

| | CONDITION OF RESERVOIR | | | | | |
|---|---|---|---|---|---|---|
| | Full | | | | | Empty |
| | Position of Resultant | Sliding | Mr/Mo | $S_v$ | $S_s$ | $S_v$ |
| Elev. | | Factor | | Lbs. | Per Sq. | In |
| 163 | 7.7 | 0.53 | 1.9 | 48 | 15 | 24 |
| 155 | 5.7 | 0.51 | 1.9 | 63 | 19 | 33 |

STABILITY FACTORS
Stresses At Downstream Face

LEGEND
Limits of Middle Third — — — — —
Position of Resultant ————————

NOTATION

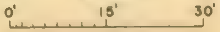
$S_v$ = Vertical stress

$S_s$ = Shear stress on horizontal plane = $\frac{\text{Horizontal force}}{\text{Area}}$

Sliding factor = $\frac{\text{Horizontal force}}{\text{Weight-Uplift}}$

$\frac{Mr}{Mo}$ = Safety factor against overturning = $\frac{\text{Resisting moment}}{\text{Overturning moment}}$

SCALE



ST. LAWRENCE RIVER PROJECT

# MASSENA CANAL INTAKE WORKS

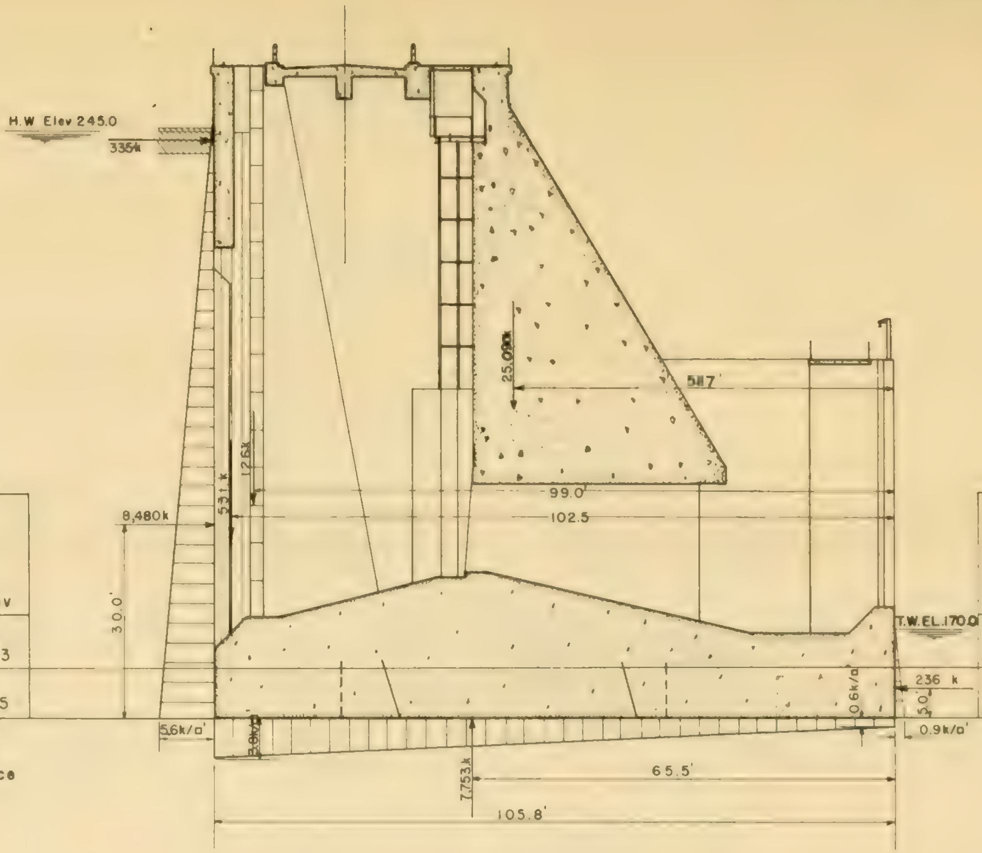
STABILITY ANALYSIS

FORCES ARE ON ONE 33.5-FOOT SPILLWAY BAY

SKETCH NO. LW A 5

LOADING CONDITIONS:

H. W. ELEV. 245.0
ICE. 10K/FT. AT ELEV. 244.0
T. W. ELEV. 170.0
ASSUMED UPLIFT: $\frac{2}{3}$ HEAD



| CONDITION OF RESERVOIR | | | |
|---|---|---|---|
| Full | Empty | | |
| $S_v$ | $S_v$ | Position of Resultant | Elev |
| Lbs. Per. Sq. In. | | | |
| 38 | 58 | 10.4 | 163 |
| 39 | 66 | 11.6 | 155 |

STABILITY FACTORS
Stresses At Upstream Face

| | CONDITION OF RESERVOIR | | | | | | |
|---|---|---|---|---|---|---|---|
| | Full | | | | | | Empty |
| | Position of Resultant | Sliding Factor | $\frac{Mr}{Mo}$ | $S_v$ | $S_s$ | | $S_v$ |
| Elev. | | | | Lbs Per Sq. In | | | |
| 163 | 8.4 | 0.49 | 2.0 | 47 | 14 | | 24 |
| 155 | 6.4 | 0.48 | 1.9 | 62 | 17 | | 33 |

STABILITY FACTORS
Stresses At Downstream Face

LEGEND
Limits of Middle Third — — — — —
Position of Resultant ————————

NOTATION

$S_v$ = Vertical stress

$S_s$ = Shear stress on horizontal plane = $\frac{\text{Horizontal force}}{\text{Area}}$

Sliding factor = $\frac{\text{Horizontal force}}{\text{Weight-Uplift}}$

$\frac{Mr}{Mo}$ = Safety factor against overturning = $\frac{\text{Resisting moment}}{\text{Overturning moment}}$

SCALE
0' 15' 30'

ST. LAWRENCE RIVER PROJECT

# MASSENA CANAL INTAKE WORKS

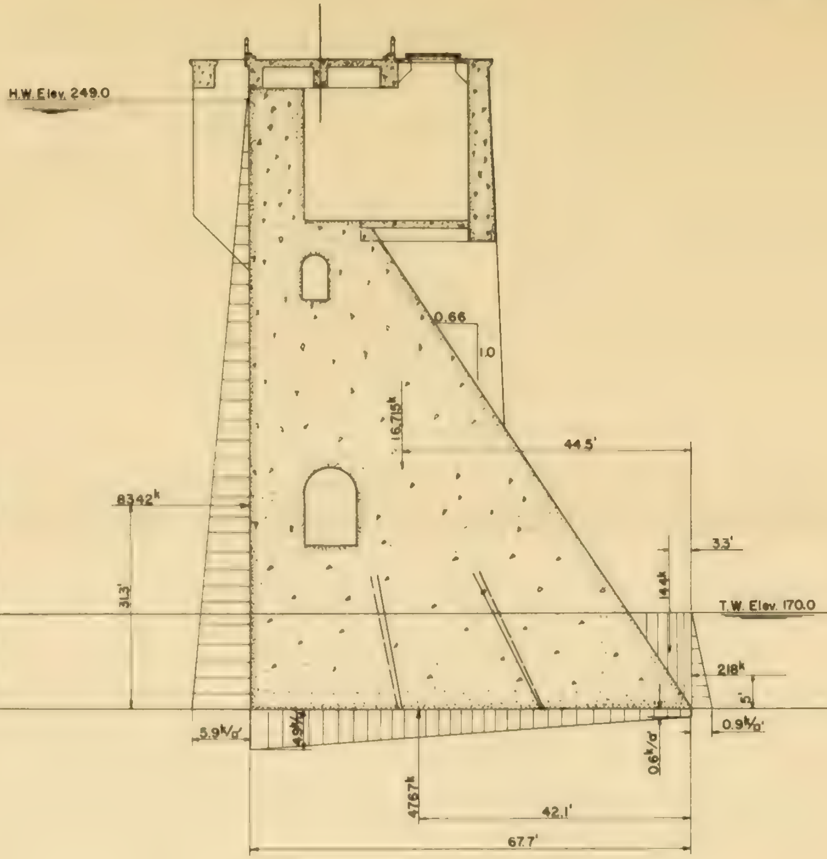
## STABILITY ANALYSIS

FORCES ARE ON ONE 335-FOOT SPILLWAY BAY

SKETCH NO. L.W. A 15-2

PLATE IX-2

LOADING CONDITIONS:
H. W. ELEV. 249.0
T. W. ELEV. 170.0
NO ICE
ASSUMED UPLIFT: $\frac{2}{3}$ HEAD



| CONDITION OF RESERVOIR | | | |
|---|---|---|---|
| Full | Empty | | |
| $S_v$ | $S_v$ | Position of Resultant | |
| Lbs. Per Sq. in. | | | Elev. |
| 26 | 90 | 1.0 | 170.0 |
| 35 | 107 | 0.6 | 155.0 |

STABILITY FACTORS
Stresses at Upstream Face

| | CONDITION OF RESERVOIR | | | | | |
|---|---|---|---|---|---|---|
| | Full | | | | | Empty |
| | Position of Resultant | Sliding Factor | Mr / Mo | $S_v$ | $S_s$ | $S_v$ |
| Elev. | | | | Lbs. Per Sq. in. | | |
| 170.0 | 0.9 | 0.64 | 1.7 | 69 | 23 | 5 |
| 155.0 | 0.3 | 0.69 | 1.6 | 83 | 28 | 3 |

STABILITY FACTORS
Stresses at Downstream Face

LEGEND
Limits of Middle Third — — — —
Position of Resultant ————

NOTATION

$S_v$ - Vertical stress
$S_s$ - Shear stress on horizontal plane - $\frac{\text{Horizontal force}}{\text{Area}}$
Sliding factor - $\frac{\text{Horizontal force}}{\text{Weight Uplift}}$
$\frac{Mr}{Mo}$ - Safety factor against overturning - $\frac{\text{Resisting moment}}{\text{Overturning moment}}$

SCALE
0 15 30

ST. LAWRENCE RIVER PROJECT

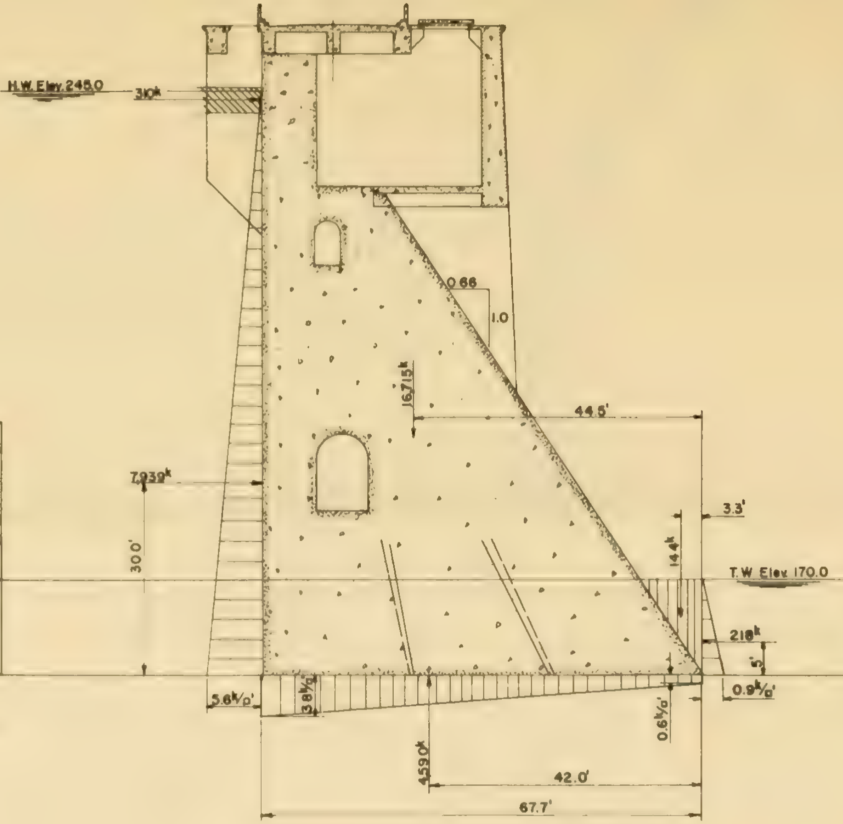
## MASSENA CANAL INTAKE WORKS

STABILITY ANALYSIS
FORCES ARE ON ONE 31-FOOT BULKHEAD BAY

Sketch No. LW-A-5/3

PLATE IX-3

LOADING CONDITIONS:
H. W. ELEV. 245.0
ICE: 10K/FT. AT ELEV. 244.0
T. W. ELEV. 170.0
ASSUMED UPLIFT: $\frac{2}{3}$ HEAD



| CONDITION OF RESERVOIR | | | |
|---|---|---|---|
| Full | Empty | | |
| $S_v$ | $S_v$ | Position of Resultant | |
| Lbs. Per Sq. In. | | | Elev. |
| 26 | 90 | 1.0 | 170.0 |
| 30 | 107 | 0.6 | 155.0 |

STABILITY FACTORS
Stresses at Upstream Face

| | CONDITION OF RESERVOIR | | | | | |
|---|---|---|---|---|---|---|
| | FULL | | | | | EMPTY |
| | Position of Resultant | Sliding Factor | Mr. / Mo | $S_v$ | $S_s$ | $S_v$ |
| Elev. | | | | Lbs. Per Sq In. | | |
| 170.0 | 1.2 | 0.60 | 1.7 | 69 | 22 | 5 |
| 155.0 | 1.0 | 0.55 | 1.6 | 81 | 26 | 3 |

STABILITY FACTORS
Stresses at Downstream Face

LEGEND
Limits of Middle Third — — — —
Position of Resultant ————

NOTATION

$S_v$ = Vertical stress

$S_s$ = Shear stress on horizontal plane = $\frac{\text{Horizontal force}}{\text{Area}}$

Sliding factor = $\frac{\text{Horizontal force}}{\text{Weight Uplift}}$

$\frac{Mr}{Mo}$ = Safety factor against overturning = $\frac{\text{Resisting moment}}{\text{Overturning moment}}$

SCALE
0 15' 30'

ST. LAWRENCE RIVER PROJECT

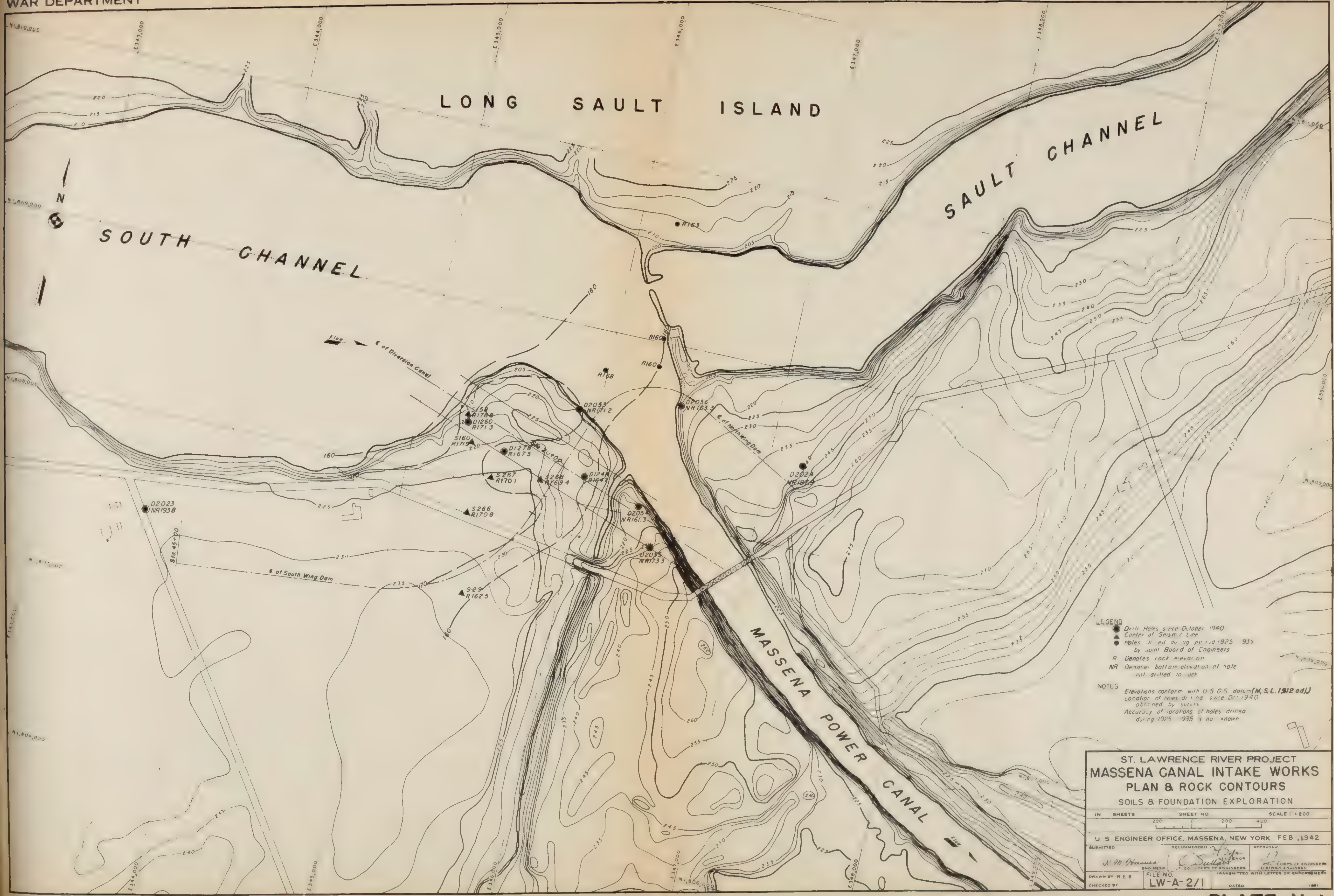
# MASSENA CANAL INTAKE WORKS

## STABILITY ANALYSIS

FORCES ARE ON ONE 31-FOOT BULKHEAD BAY

Sketch No. LW-A-15/4

PLATE IX 4



LEGEND
- ● Drill Holes since October 1940
- ▲ Center of Seismic Line
- ● Holes drilled during period 1925 935 by Joint Board of Engineers
- R Denotes rock elevation
- NR Denotes bottom elevation of hole not drilled to rock

NOTES

Elevations conform with U.S.G.S. datum (M.S.L. 1912 adj.)

Location of holes drilled since Oct 1940 obtained by survey

Accuracy of locations of holes drilled during 1925 935 is not known

### ST. LAWRENCE RIVER PROJECT
## MASSENA CANAL INTAKE WORKS
### PLAN & ROCK CONTOURS
SOILS & FOUNDATION EXPLORATION

IN SHEETS SHEET NO SCALE 1" = 200

200 0 200 400

U S ENGINEER OFFICE, MASSENA, NEW YORK FEB , 1942

SUBMITTED R M Haines ENGINEER

RECOMMENDED LT. COL. CORPS OF ENGINEERS

APPROVED COL. CORPS OF ENGINEERS DISTRICT ENGINEER

DRAWN BY R E B

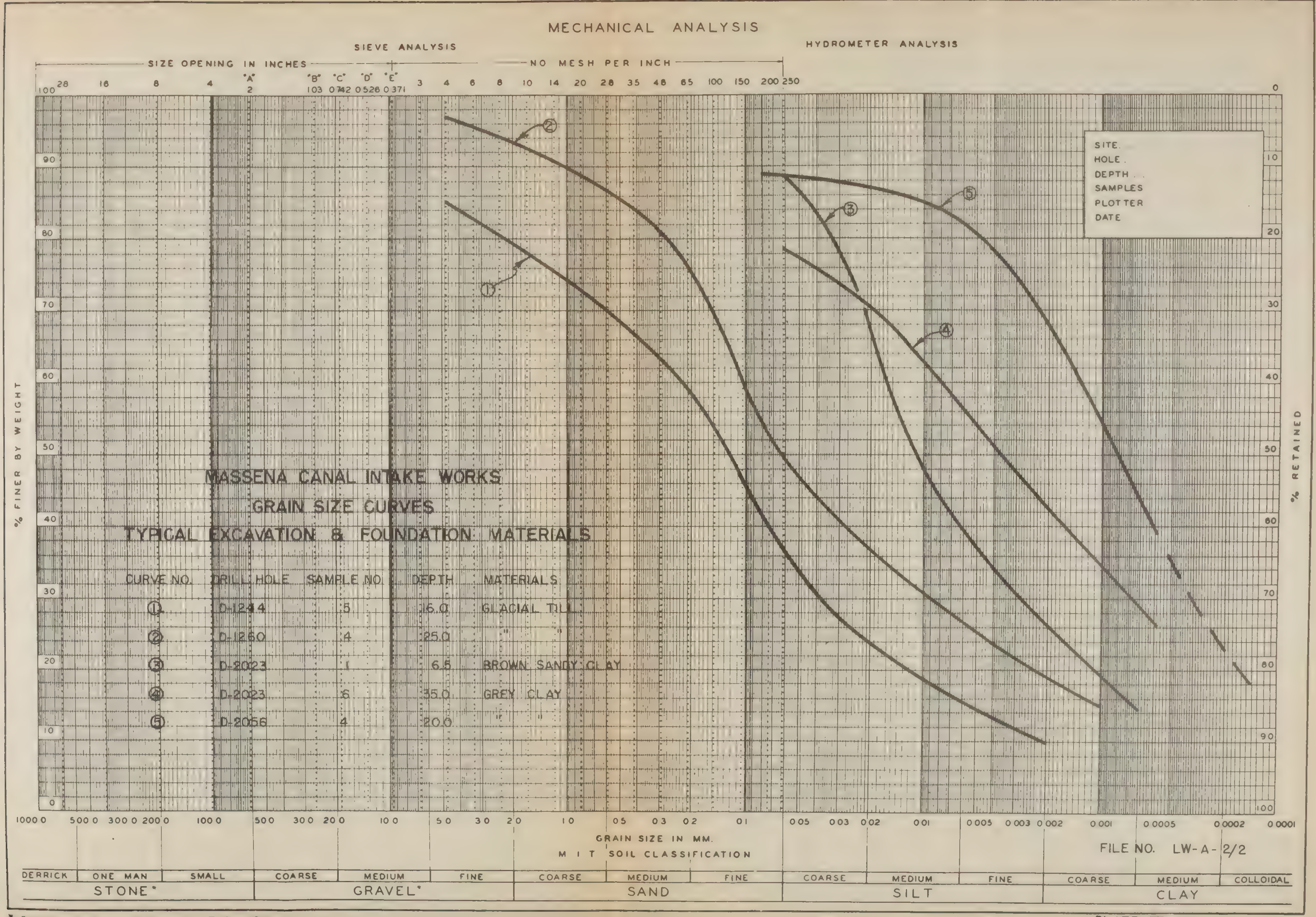
CHECKED BY

FILE NO. LW-A-2/1

TRANSMITTED WITH LETTER OR ENDORSEMENT

DATED 19

**PLATE X-1**



## MASSENA CANAL INTAKE WORKS
## GRAIN SIZE CURVES
## TYPICAL EXCAVATION & FOUNDATION MATERIALS

| CURVE NO. | DRILL HOLE | SAMPLE NO. | DEPTH | MATERIALS |
|---|---|---|---|---|
| ① | D-1244 | 5 | 16.0 | GLACIAL TILL |
| ② | D-1260 | 4 | 25.0 | " " |
| ③ | D-2023 | 1 | 6.5 | BROWN SANDY CLAY |
| ④ | D-2023 | 6 | 35.0 | GREY CLAY |
| ⑤ | D-2056 | 4 | 20.0 | " " |

FILE NO. LW-A-2/2

* These sizes not included in original M I T Classification

PLATE XI -1

SL-5.00

# PART TWO

# MASSENA CANAL INTAKE WORKS

## ESTIMATE OF COST

## MASSENA CANAL INTAKE WORKS

Estimate of Cost - March 18, 1942

---

### SUMMARY

---

| | | |
|---|---|---|
| 1. | General Contract | $2,413,317 |
| 2. | Materials & Equipment | 925,255 |
| | | $3,338,572 |
| 3. | Engineering & Contingencies 18%± | 601,428 |
| | Total Cost | $3,940,000 |

# MASSENA CANAL INTAKE WORKS

## Estimate of Cost - March 18, 1942

| Item No. | Designation | Unit | Quantity | Unit Price $ | Amount $ |
|---|---|---|---|---|---|
| 1 | Earth Fill; Cofferdams | Cu.Yd. | 32,210 | .50 | 16,105 |
| 2 | Rock Fill; Cofferdams | " " | 164,000 | 2.50 | 410,000 |
| 3 | Unwatering Foundations | Sum | Job | | 50,000 |
| 4 | Excavation; Common | Cu.Yd. | 847,000 | .40 | 338,800 |
| 5 | Excavation; Rock | " " | 11,900 | 2.00 | 23,800 |
| 6 | Excavation; Borrow | " " | 666,000 | .30 | 199,800 |
| 7 | Line Drilling | Sq.Ft. | 11,600 | 1.00 | 11,600 |
| 8 | Drilling 3" Exploratory Holes | Lin.Ft. | 3,000 | 5.00 | 15,000 |
| 9 | Drilling 6" Concrete Cores | " " | 500 | 10.00 | 5,000 |
| 10 | Drilling 6" Foundation Drains | " " | 800 | 10.00 | 8,000 |
| 11 | Drilling Foundation Grout Holes in Rock | " " | 10,000 | 4.50 | 45,000 |
| 12 | Drilling Foundation Grout Holes in Concrete | " " | 1,000 | 2.50 | 2,500 |
| 13 | Core Boxes | Each | 200 | 2.00 | 400 |
| 14 | Providing Pressure Grouting Equipment | Sum | Job | | 5,000 |
| 15 | Pressure Grouting | Cu. Ft. | 10,000 | 1.00 | 10,000 |
| 16 | Rock Flour in Grout | " " | 2,000 | .50 | 1,000 |
| 17 | Sand in Grout | " " | 2,000 | .25 | 500 |
| 18 | Earth Fill; Compacted, Class I & Class II | Cu. Yd. | 1,086,000 | .12 | 130,320 |
| 19 | Additional Compaction | Square (100sf) | 250,000 | .02 | 5,000 |
| 20 | Fill, Class III | Cu. Yd. | 381,000 | .10 | 38,100 |
| 21 | Filter | " " | 51,000 | 2.00 | 102,000 |
| 22 | Riprap; Dumped, Class A | Cu. Yd. | 20,000 | 3.00 | 60,000 |
| 23 | Riprap; Dumped, Class B | " " | 77,600 | 2.50 | 194,000 |

| Item No. | Designation | Unit | Quantity | Unit Price $ | Amount $ |
|---|---|---|---|---|---|
| 24 | Sand and Gravel Backing | Cu. Yd. | 17,000 | 1.75 | 29,750 |
| 25 | Rolled Gravel Surface | Sq. Yd. | 4,700 | .50 | 2,350 |
| 26 | Seeding | Acres | 10 | 250.00 | 2,500 |
| 27 | Concrete; Class A | Cu. Yd. | 1,300 | 10.00 | 13,000 |
| 28 | Concrete; Class B | " " | 91,200 | 6.00 | 547,200 |
| 29 | Special Bituminous Fillers; Type C | Cu. Ft. | 230 | 1.50 | 345 |
| 30 | Steel Erection; Concrete Reinforcing | Lb. | 3,000,000 | .025 | 75,000 |
| 31 | Steel Erection; Structural | " | 466,000 | .03 | 13,980 |
| 32 | Steel; Structural, Miscellaneous | " | 1,000 | .18 | 180 |
| 33 | Steel Forgings; Miscellaneous | " | 200 | .30 | 60 |
| 34 | Control Gates; Erection | " | 456,000 | .022 | 10,032 |
| 35 | Hoists and Gantry Crane; Erection | Sum | Job | | 6,000 |
| 36 | Iron; Cast | Lb. | 6,500 | .16 | 1,040 |
| 37 | Pipe; Cast Iron | " | 10,000 | .15 | 1,500 |
| 38 | Pipe; Wrought Iron | " | 2,600 | .25 | 650 |
| 39 | Pipe; Black Steel | " | 7,500 | .15 | 1,125 |
| 40 | Pipe; Concrete, Halved | Lin.Ft. | 1,000 | .20 | 200 |
| 41 | Drains; Porous Concrete | " " | 3,960 | 1.00 | 3,960 |
| 42 | Corrugated Iron Water Stops | Lb. | 11,600 | .15 | 1,740 |
| 43 | Cable Guard Rail | Lin.Ft. | 3,800 | 1.25 | 4,750 |
| 44 | Bridge Guard Rail | " " | 1,270 | 4.00 | 5,080 |
| 45 | Handrailing; Steel Pipe 2" | " " | 1,300 | 3.00 | 3,900 |
| 46 | Handrailing; Steel Pipe 1-1/2" | " " | 300 | 2.50 | 750 |
| 47 | Safety Treads | Lb. | 500 | .20 | 100 |
| 48 | Floor Grating; Steel | " | 12,400 | .15 | 1,860 |

| Item No. | Designation | Unit | Quantity | Unit Price $ | Amount $ |
|---|---|---|---|---|---|
| 49 | Conduit; Metal | Lb. | 1,000 | .25 | 250 |
| 50 | Doors; Steel | " | 1,450 | .20 | 290 |
| 51 | Air Bubbler System | Sum | Job | | 2,000 |
| 52 | Stoplogs; Timber | " | " | | 6,000 |
| 53 | Hatch Covers; Timber | " | " | | 1,000 |
| 54 | Miscellaneous Equipment; Placing | Lb. | 470,000 | .01 | 4,700 |
| 55 | Electric Grounding System | Sum | Job | | 100 |
| | | | Total | | $2,413,317 |

## MASSENA CANAL INTAKE WORKS

### Estimate of Cost - March 18, 1942

### Materials & Equipment Furnished by Government

| Item No. | Designation | Unit | Quantity | Unit Price $ | Amount $ |
|---|---|---|---|---|---|
| 1 | Fine Aggregate | Ton | 60,100 | 1.25 | 75,125 |
| 2 | Coarse Aggregate | " | 129,500 | 1.10 | 142,450 |
| 3 | Portland Cement | Bbl. | 115,600 | 2.50 | 289,000 |
| 4 | Structural Steel | Lb. | 466,000 | .07 | 32,620 |
| 5 | Reinforcing Steel | " | 3,000,000 | .04 | 120,000 |
| 6 | Control Gates | " | 456,000 | .22 | 100,320 |
| 7 | Crane & Hoists | Sum | Job | | 90,000 |
| 8 | Electrical Contract | " | " | | 40,000 |
| 9 | Permanent Stoplogs | Lbs. | 198,000 | .08 | 15,840 |
| 10 | Temporary Stoplogs, Steel Frames | " | 270,000 | .06 | 16,200 |
| 11 | Lifting Beams | " | 2,000 | .10 | 200 |
| 12 | Monorail Hoist | Sum | Job | | 500 |
| *13 | Miscellaneous Equipment | " | " | | 3,000 |
| | | | Total Cost | | $925,255 |

*Include ventilating equipment, machine shop equipment, etc.

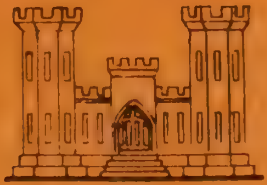
# ST. LAWRENCE RIVER PROJECT

# FINAL REPORT

## 1942

DOCUMENTS Room 8

# LONG SAULT CANAL SPECIFICATIONS



CORPS OF ENGINEERS, U.S. ARMY

U.S. ENGINEER OFFICE • MASSENA, NEW YORK.

APPENDIX III-16 (2)

# ST. LAWRENCE RIVER

# PROJECT

* * * * *

# FINAL REPORT

# 1942

# LONG SAULT CANAL

# SPECIFICATIONS

CORPS OF ENGINEERS, U.S. ARMY

U.S. Engineer Office - Massena, New York

July , 1942

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Long Sault Canal Invitation No. ________

No. ________ Bidder ______________________________

(Do not write above this line)

# STANDARD GOVERNMENT FORM OF INVITATION FOR BIDS

## (CONSTRUCTION CONTRACT)

WAR DEPARTMENT
UNITED STATES ENGINEER OFFICE
MASSENA, NEW YORK
1942

1. SEALED BIDS, in duplicate, subject to the conditions contained herein, will be received until 2:00 P.M. E.S.T. ________ and then publicly opened in the United States Engineer Office, Massena, New York, for furnishing all labor, plant, and materials, and performing all the work of excavation and dike construction on the Long Sault Canal, adjacent to the St. Lawrence River, about 4 miles north of the village of Massena, New York, as indicated on the drawings or required by the specifications.

2. SPECIFICATIONS AND PLANS.

(a) The work shall be done in strict accordance with the specifications and drawings which are designated as follows:

(1) Long Sault Canal, specifications.

(2) The drawings which will become a part of this contract are designated in paragraph 1-04 of the specifications.

(b) Where copies of drawings are requested, a deposit of twenty-five dollars ($25.00) will be required to insure their return. The deposit should be in the form of a United States money order or a certified check made payable to "The Treasurer of the United States." The deposit will be refunded upon the return of the plans in good condition within 30 days after date of opening bids.

3. INVESTIGATION OF CONDITIONS. - Bidders are expected to visit the locality and site of the work, and to make their own estimates of the facilities needed, and the difficulties attending the execution of the proposed contract, including local conditions, availability of labor, uncertainty of weather, and other contingencies. In no case will the Government assume any responsibility whatever for any interpretation, deduction, or conclusion drawn from the examination of the site. At the bidder's request, a representative of the Government will point out the site of the proposed operation. Failure to acquaint himself with all available information concerning these conditions will not relieve the successful bidder of assuming all responsibilities for estimating the difficulties and costs of successfully performing and completing the work. (See paragraphs 1-17 of the specifications.)

4. WAGE AND LABOR PROVISIONS. - Wage, labor, and anti-discrimination regulations are specified in paragraph 1-32 of the specifications and Articles 11 (revised), 17, and 19 (revised), of the contract. Attention of bidders is invited to War Department labor policy for defense construction projects set

out in memorandum of agreement approved July 22, 1941. Successful bidders will be expected to adhere to provisions of the agreement, copies of which are on file at the office of the District Engineer, U. S. Engineer Office, Massena, N. Y.

5. DOMESTIC PREFERENCE.- Articles on the preference for domestic articles will be made a part of the contract. (See paragraph 1-29 of the specifications.)

6. ARTICLES ON PATENTS will be made a part of the contract. (see paragraph 1-26 of the specifications.)

7. COMMENCEMENT AND COMPLETION - The work shall be commenced within 20 calendar days after date of receipt of notice to proceed and shall be completed in accordance with the provisions of paragraph 1-06 of the specifications.

8. EXTENSION OF TIME FOR COMPLETION OF CONSTRUCTION FOR DELAYS DUE TO NATIONAL DEFENSE PRIORITIES will be made. (See paragraph 1-06(c) of the specifications.)

9. LIQUIDATED DAMAGES for delay will be prescribed. (See paragraph 1-06 of the specifications.)

10. PARTIAL PAYMENTS will be made. (See paragraph 1-08 of the specifications and Article 16 of the contract.)

11. ADJUSTMENT OF CONTRACT PRICE by reason of change in Federal, state, and local taxes will be made. (See paragraph 1-36 of the specifications.)

12. ADJUSTMENT OF PRICES FOR LABOR AND MATERIALS.- Adjustment of prices in accordance with basic or decrease of costs of labor and material will be made as provided in paragraph 1-40 of the specifications.

13. ASSIGNMENT OF CLAIMS.- The work under these specifications will be subject to the provisions of the Assignment of Claims Act of 1940 (Pub. No. 811, 76th Congress). (See paragraph 1-39 of these specifications.)

14. ESTIMATES OF COST.- Bidders are informed that the Government will prepare extimates of the cost of construction of the work required by the specifications for comparison of bids.

15. REPORTS TO THE DEPARTMENT OF LABOR.- In order to assist the Department of Labor in obtaining employment statistics, bidders, unless otherwise indicated in their bids, will be considered as having voluntarily consented, without cost to the Government, to the inclusion of paragraph 1-33 of the specifications as a part of the contract.

16. BID AND CONTRACT.

(a) Bids must be submitted upon the standard Government form of bid, and the successful bidder will be required to execute the standard Government form of contract for construction (U. S. Standard Form No. 23). Bidders are advised that Article 11(a) of U. S. Standard Form No. 23 has been revised to permit laborers and mechanics to work more than 8 hours per day, provided overtime compensation at a rate of not less than 1-1/2 times the basic rate of pay is paid for all working time of each laborer or mechanic in excess of 8 hours in any one day.

(b) The bid form has an entry for each item on which estimates will be given or payments made, and no other allowance of any kind will be made unless specifically provided for in the specifications or the contract, or adjustments under Article 3 of the contract.

(c) All bids must be for the entire work in each section or combination of sections and must have each blank filled in for each section or combination of sections.

(d) The quantities of each item of the bid as finally ascertained at the close of the contract, in the units given, and the unit price of the several items stated by the bidder in the accepted bid, will determine the total payments to accrue under the contract. The unit price bid for each item must allow for all collateral or indirect cost connected with it.

## 17. DATA TO BE SUBMITTED WITH BIDS.

(a) All bids submitted must be accompanied by a statement establishing that the bidder maintains a permanent place of business and has a suitable financial status to meet obligations incident to the work. (See paragraph 3 of the bidding schedule.) In addition, each bidder shall submit with his bid the statement of plant, drawings, charts, and other information and data required below. These data shall be carefully prepared and presented in neat and legible form on tracing paper or tracing cloth so that reproduction may be made therefrom. These data are considered essential in enabling the contracting officer to determine whether the bidder is responsible and experienced in similar types of construction and whether the bid is based on a careful study of construction methods applicable to the work and full realization of the various factors which may affect the progress of the work. Award of this contract shall not be construed as a guarantee by the Government that the plant, materials, or supplies listed in the bidding schedule are approved.

(b) Each bidder shall state in the space provided in the bidding schedule a brief description of the character of the work previously executed by him and the locations of the major projects. After the bids are opened, any bidder may be required by the contracting officer to state whether he is now or ever has been engaged on any construction work similar to that proposed, the year in which it was done, and the manner of its execution, and to give such other information as will tend to show his ability to prosecute vigorously the work required by these specifications. (See paragraph 2 of the bidding schedule.)

(c) Drawings shall be submitted indicating the plant layout the bidder proposes to utilize on the work. The drawings shall clearly indicate the location and manner of employment of the various major items of the plant. They shall also include the location of all material yards and the transportation facilities. The plant layout shall be accompanied by a complete list and description inserted in the space provided therefor in the bid form, of all plant, that the bidder now has or will have available for commencing and prosecuting this work, and its location at the time of opening bids, in order that it may be inspected by the contracting officer should he so desire. The above information will be considered confidential. When a bidder does not own or possess plant and proposes to procure it, firm options on all major items of proposed plant must be submitted when the bids are opened.

(d) A chart or charts shall be submitted indicating the volume of work to be done and the rate of progress which the bidder agrees to maintain (see paragraph 1-16 of the specifications) for each of the following major operations required in the performance of the work under these specifications:

(1) Excavation Long Sault Canal
(2) Dike 1
(3) Dike 3
(4) Dike 5
(5) Dike 6

Charts shall be in the form of plotted curves in which the abscissae shall represent definite intervals of time measured from date of receipt of notice to proceed with the work, and the ordinates shall represent percentages of completion based on the estimated contract quantities. In preparing the charts, due allowance shall be made for probable delays caused by any unsatisfactory working conditions. Careful consideration shall be given to the preparation of these charts as the rate of progress proposed by the accepted bid will be made a part of the contract. (See paragraph 1-16 of the specifications.)

### 18. AWARD OF CONTRACT.

(a) Subject to the rights hereinafter reserved, work will be awarded by sections, or by combinations of sections, to one or more bidders, as may be to the best advantage of the United States.

(b) Bidders are invited to bid on all the work in the three sections or combinations of sections advertised. Each bidder must state in his bid the maximum number of sections of the work he is willing and able to undertake. If it is determined that he is the lowest responsible bidder on more than one section, but states in his bid a less number of sections of work that he is willing and able to undertake, then the section or sections deemed most advantageous to the United States may be awarded him. For the remaining sections the bid of the next lowest responsible bidder shall be considered the lowest bid received, and so on until all sections have been awarded. In making awards no section will be subdivided.

(c) A bid may be rejected if the bidder fails to furnish bid bond or to submit the data required with his bid or cannot show that he has the necessary capital and experience and owns, controls, or can procure the necessary plant to commence the work at the time prescribed in the specifications and thereafter to prosecute and complete the work at the rate or time specified; and that he is not already obligated for the performance of other work which would delay the commencement, prosecution, or completion of the work contemplated in this advertisement.

(d) Any unbalanced bid which, in the opinion of the contracting officer, jeopardizes the interest of the United States will be subject to rejection for that reason.

(e) The right is reserved, as the interest of the Government may require, to reject any and all bids and to waive any informality in bids received.

19. GUARANTY. - Guaranty will be required with each bid as follows: Bid Bond, Standard Form No. 24, will be executed in a penal sum not less than 10 percent of the total amount of the bid but not exceeding $2,500,000.

Individual sureties will justify in sums aggregating not less than double the penalty of the bid bond. (See paragraphs 8 and 9 of the Instructions to Bidders.)

20. PERFORMANCE AND PAYMENT BONDS will be required as follows:

(a) A performance bond with good and sufficient surety or sureties, for the protection of the United States, Standard Form No. 25, will be executed in a penal sum approximately equal to and not less than ten percent (10%) of the full amount of the consideration of the contract, but not exceeding $2,500,000.

(b) If the consideration of the contract will exceed $2,000 in amount, a payment bond with good and sufficient surety or sureties, for the protection of persons furnishing material and labor for the work, Standard Form No. 25-A, will be executed in a penal sum of one half of the full amount of the consideration of the contract when the latter is not more than one million dollars ($1,000,000); forty percent (40%) where the contract exceeds one million dollars ($1,000,000) but is not more than five million dollars ($5,000,000); and two million five hundred thousand dollars ($2,500,000) for all contracts above five million dollars ($5,000,000).

21. ADDRESS FOR BIDS. - Envelopes containing bids must be sealed, marked, and addressed as follows:

Mark in upper
left-hand corner:

Bid for Construction of
Long Sault Canal

Invitation No.________
To be opened at 2:00 P.M., E.S.T.

______________________________

Address:

To: The District Engineer,
U. S. Engineer Office
Massena, New York

Note: See Standard Government Instructions to Bidders and copy of the Standard Government Form of Contract, Bid Bond, Payment Bond, and Performance Bond, which may be obtained upon application.

WAR DEPARTMENT
St. Lawrence River District
U. S. Engineer Office
Massena, N. Y.

APPROPRIATION:

## SECTION I - GENERAL PROVISIONS

1-01. LOCATION. - The site of the work covered by these specifications is located in northern New York State, in the county of St. Lawrence, near the International Rapids Section of the St. Lawrence River. The canal will extend from Richards Point, about four miles northwest of Massena, New York to the St. Lawrence River at the mouth of the Grass River, about seven miles east of Massena, New York. For Transportation facilities see paragraph 1-15,

1-02. WORK TO BE DONE.

(a) The work provided herein is authorized by____________________ Act, approved____________________, 194

(b) The work to be done under this contract and in accordance with these specifications consists of furnishing all plant, superintendence, labor and materials, and performing all the work of excavation and dike construction on the Long Sault Canal complete in accordance with the drawings and these specifications.

(c) It is not believed that ledge rock will be encountered within the limits of required excavation. If ledge rock is encountered, excavation of same will not be required.

(d) For purposes of bidding the work is divided into sections as follows:

### Section A

Richards Point, station 43 + 80 to Long Sault Island South Channel, Station 187 + 60, a length of approximately 2.72 miles.

### Section B

Long Sault Island South Channel, Station 187 + 60 to Robinson Bay Lock Site, Station 354 + 35,a length of approximately 3.26 miles. This section includes canal excavation and the construction of Dikes Nos. 1 and 3.

### Section C

Robinson Bay Lock Site, Station 383 + 11 to the vicinity of the mouth of Grass River, Station 515 + 00 a length of approximately 2.5 miles. This section includes canal excavation, and the construction of Dikes Nos. 5 and 6.

All of the stations noted above refer to measurements along the centerline of the canal and are approximate only.

(e) For Purposes of acceptance the sections of work are divided into subsections as follows:

## Section A

| Subsection | Approximate Station to Station on Centerline of Canal |
|---|---|
| 1 Canal Excavation. | 43 + 80 - to 71 + 00 |
| 2 Canal Excavation. | 86 + 00 - to 94 + 00 |
| 3 Canal Excavation. | 114 + 00 - to 187 + 60 |

## Section B

| Subsection | Approximate Station to Station on Centerline of Canal |
|---|---|
| 4 Canal Excavation | 187 + 60 to 214 + 00 |
| 5 Canal Excavation | 227 + 00 to 260 + 00 |
| 6 Canal Excavation | 260 + 00 to 320 + 00 |
| 7 Canal Excavation | 320 + 00 to 354 + 35 |
| 8 Construction of Dike No. 1 | 0 + 00 to 78 + 00 |
| 9 Construction of Dike No. 3 | 0 + 00 to 20 + 00 |
| 10 Construction of Dike No. 3 | 20 + 00 to 70 + 00 |

## Section C

| Subsection | Approximate Station to Station on Centerline of Canal |
|---|---|
| 11 Canal Excavation | 383 + 11 to 425 + 00 |
| 12 Canal Excavation | 425 + 00 to 448 + 00 |
| 13 Canal Excavation | 448 + 00 to 464 + 00 |
| 14 Canal Excavation | 464 + 00 to 500 + 00 |
| 15 Canal Excavation | 500 + 00 to 515 + 00 |
| 16 Construction of Dike No. 5 | 0 + 00 to 22 + 60 |
| 17 Construction of Dike No. 6 | 0 + 00 to 38 + 70 |

1-03. DESCRIPTION. - The proposed canal will have an overall length of approximately 10 miles and the bottom width generally 442 feet with depths of excavation varying from zero to about 50 feet. From the upstream end to Robinson Bay Lock site, (Stations 43 + 80 to 354 + 35), the canal shall be excavated to a bottom grade of elevation 210.5, mean sea level datum, and from Robinson Bay Lock site to Grass River Lock site, (Station 383 + 11 to 515 + 00), to elevation 173. Dike embankments vary in height from zero to about 44 feet and shall be constructed from materials obtained from canal excavation.

1-04. MAPS AND DRAWINGS.

(a) The work shall conform to maps and drawings marked "St. Lawrence River Project, Long Sault Canal", titled and file marked as listed below, which form a part of these specifications and which are filed in the U. S. Engineer Office, St. Lawrence River District, Massena, New York.

# LIST OF DRAWINGS

## LONG SAULT CANAL

### GENERAL DRAWINGS

| Sheet No. | File No. | Title |
|---|---|---|
| 1 | MC-1-0/1 | Index |
| 2 | 1/1 | General Plan and Profile |
| 3 | 1/2 | Project Location Map |
| 4 | 1/3 | Project Location Map |

### EXCAVATION

| Sheet No. | File No. | Title |
|---|---|---|
| 5 | MC-1-10/1 | Plan of Borings & Probings - Station 43 + 80 to 113 + 60 |
| 6 | 10/2 | Plan of Borings & Probings - Station 113 + 60 to 189 + 00 |
| 7 | 10/3 | Plan of Borings & Probings - Station 189 + 00 to 265 + 40 |
| 8 | 10/4 | Plan of Borings & Probings - Station 265 + 40 to 340 + 70 |
| 9 | 10/5 | Plan of Borings & Probings - Station 340 + 70 to 412 + 90 |
| 10 | 10/6 | Plan of Borings & Probings - Station 412 + 90 to 485 + 25 |
| 11 | 10/7 | Plan of Borings & Probings - Station 485 + 25 to 534 + 70 |
| 12 | 10/8 | Borings & Probings - Station 43 + 80 to 60 + 00 |
| 13 | 10/9 | Borings & Probings - Station 60 + 00 to 90 + 00 |
| 14 | 10/10 | Borings & Probings - Station 90 + 00 to 120 + 00 |
| 15 | 10/11 | Borings & Probings - Station 120 + 00 to 150 + 00 |
| 16 | 10/12 | Borings & Probings - Station 150 + 00 to 180 + 00 |
| 17 | 10/13 | Borings & Probings - Station 180 + 00 to 210 + 00 |
| 18 | 10/14 | Borings & Probings - Station 210 + 00 to 240 + 00 |
| 19 | 10/15 | Borings & Probings - Station 240 + 00 to 270 + 00 |
| 20 | 10/16 | Borings & Probings - Station 270 + 00 to 300 + 00 |
| 21 | 10/17 | Borings & Probings - Station 300 + 00 to 330 + 00 |
| 22 | 10/18 | Borings & Probings - Station 330 + 00 to 360 + 00 |
| 23 | 10/19 | Borings & Probings - Station 380 + 00 to 410 + 00 |
| 24 | 10/20 | Borings & Probings - Station 410 + 00 to 440 + 00 |
| 25 | 10/21 | Borings & Probings - Station 440 + 00 to 470 + 00 |
| 26 | 10/22 | Borings & Probings - Station 470 + 00 to 500 + 00 |
| 27 | 10/23 | Borings & Probings - Station 500 + 00 to 530 + 00 |
| 28 | 10/24 | Additional Borings & Probings - Station 43 + 80 to 300 + 00 |
| 29 | 10/25 | Additional Borings & Probings - Station 300 + 00 to 400 + 00 |
| 30 | 10/26 | Additional Borings & Probings - Station 400 + 00 to 534 + 50 |
| 31 | 10/27 | Additional Borings & Probings - Station - Spoil Area "K" and Dikes Nos. 1 and 3 |
| 32 | 10/28 | Plan - Station 43 + 80 to 113 + 60 |
| 33 | 10/29 | Plan - Station 113 + 60 to 189 + 00 |
| 34 | 10/30 | Plan - Station 189 + 00 to 265 + 40 |
| 35 | 10/31 | Plan - Station 265 + 40 to 340 + 70 |
| 36 | 10/32 | Plan - Station 340 + 70 to 412 + 90 |
| 37 | 10/33 | Plan - Station 412 + 90 to 485 + 25 |
| 38 | 10/34 | Plan - Station 485 + 25 to 515 + 00 |
| 39 | 20/1 | Plan of Dike No. 5 |
| 40 | 10/35 | Canal Cross Sections. |

### EMBANKMENT

| | | |
|---|---|---|
| 41 | MC-1-20/2 | Profiles of Dikes Nos. 1 and 3 |
| 42 | 20/3 | Profiles of Dikes Nos. 5 and 6 |
| 43 | 20/4 | Dike Cross Sections - Dikes Nos. 1, 3, 5, and 6 |
| 44 | 20/5 | Dike Cross Sections - Dikes Nos. 3 and 6 |

(b) These drawings show the work with as much detail as is possible in the present stage of development of the design. The work shall conform also other drawings and addenda relating thereto as may be published and/or exhibited in the office of the contracting officer prior to the opening of proposals, and to such drawings in explanation of details as may be required from time to time during construction, including such modifications as the contracting officer may consider necessary on account of conditions that are found to exist during the prosecution of the work.

(c) Prior to the execution of the work the contractor shall check all drawings and shall immediately report to the contracting officer any errors or omissions discovered therein. Errors and/or omissions in drawings will not relieve the contractor of his responsibility for the proper construction of the work in accordance with the specifications.

(d) Ten sets of prints of necessary contract drawings (one-Half size reproductions, or full size if desired) and twenty sets of specifications will be furnished the contractor without charge. Additional prints may be secured upon request at the cost of reproduction.

### 1-05. QUANTITIES.

(a) The following estimate of quantities of work to be performed as also shown in the "Schedule of Bid Items" under these specifications is given only to serve as a basis for canvassing bids and for determining the approximate amount of the consideration of the contract. Unless the contract is terminated by the failure of Congress to appropriate additional funds (see paragraph 1-08), the contractor will be required to complete the work specified in paragraph 1-02 hereof, be the required quantities more or less than the amounts shown.

#### Section A

| Item No. | Designation | Unit | Quantity |
|---|---|---|---|
| 1 | Excavation; Long Sault Canal | C. Y. | 3,507,000 |

#### Section B

| Item No. | Designation | Unit | Quantity |
|---|---|---|---|
| 1 | Excavation; Long Sault Canal | C.Y. | 5,458,000 |
| 2 | Earth Fill; Compacted, Class I | C.Y. | 161,000 |
| 3 | Earth Fill; Compacted, Class II | C.Y. | 1,315,000 |
| 4 | Earth Fill; Class III | C.Y. | 1,621,000 |
| 5 | Additional Rolling | Square (100sf) | 50,000 |
| 6 | Stripping; Dike Foundations | C.Y. | 169,000 |
| 7 | Riprap | C.Y. | 171,000 |

| | | | |
|---|---|---|---|
| 8 | Filter | C.Y. | 28,000 |
| 9 | Sand and Gravel Backing | C.Y. | 30,000 |
| 10 | Seeding | square<br>(100sf) | 8,700 |

## Section C

| Item No. | Designation | Unit | Quantity |
|---|---|---|---|
| 1 | Excavation; Long Sault Canal | C.Y. | 6,704,000 |
| 2 | Earth Fill; Compacted, Class I | C.Y. | 75,000 |
| 3 | Earth Fill; Compacted, Class II | C.Y. | 77,000 |
| 4 | Earth Fill; Class III | C.Y. | 25,000 |
| 5 | Additional Rolling | (100sf) - square | 25,000 |
| 6 | Stripping, Dike Foundations | C.Y. | 38,000 |
| 7 | Riprap | C.Y. | 22,000 |
| 8 | Filter | C.Y. | 7,000 |
| 9 | Sand and Gravel Backing | C.Y. | 3,000 |
| 10 | Seeding | (100sf) - square | 1,500 |

(b) "Excavation: Long Sault Canal", of Sections A, B, and C, include 100 percent of the estimated maximum quantities of allowable overdepth. The maximum amounts of allowable overdepth excavation are estimated to be 174,000 cubic yards in Section A, 300,000 cubic yards in Section B, and 332,000 cubic yards in Section C, for "Excavation; Long Sault Canal", (see paragraph 2-06).

### 1-06. COMMENCEMENT, PROSECUTION AND COMPLETION.

(a) The contractor will be required to commence work under the contract within twenty (20) calendar days after the date of receipt by him of notice to proceed, to prosecute the said work with faithfulness and energy and to complete the various portions of the work according to the following schedule:

1. Section A_______________calendar days after date of receipt of notice to proceed.
2. Section B_______________calendar days after date of receipt of notice to proceed.
3. Section C_______________calendar days after date of receipt of notice to proceed.

(b) In the case of failure on the part of the contractor to complete the work on any section within the time specified in the foregoing for its completion, plus any extensions duly granted under the contract, the contractor shall pay the Government as liquidated damages the following sums for each calendar day of delay until the work on such section is completed and accepted.

1. Section A____________________
2. Section B____________________
3. Section C____________________

(c) If the completion of the undertaking to be performed under the terms of this contract be delayed by reason of delay in the delivery of materials or supplies essential to such performance because of national defense priorities and without the fault of negligence of the contractor, the time of performance will be extended for a period equal to such delay, as determined by the contracting officer, and subject to appeal, as provided in Article 9 of the contract.

1-07. SUNDAYS, HOLIDAYS AND NIGHTS. - Work on Sundays, holidays and nights will be at the option of the contractor, However, when the contractor elects to work at such times notice of his intention to do so shall be given the contracting officer within a reasonable time in advance thereof.

1-08. PAYMENTS.

(a) (Availability of Funds?)

(b) Payments will be made monthly on estimates of work performed in accordance with the contract and not included in any prior estimate, except that ten percent (10%) of the amount of each estimate will be retained until fifty percent (50%) of the contract work is completed. Thereafter with each monthly payment there will be paid such portion of the amount so retained as is in excess of ten percent (10%) of the work remaining to be done until the amount retained is reduced to twenty-five thousand dollars ($25,000) which amount will be retained until the completion of the contract, when final payment will be made.

1-09. WORK COVERED BY CONTRACT PRICE.

The contractor shall, under his contract prices, furnish and pay for all materials, labor and equipment for all permanent, temporary, preparatory incidental work, furnish all accessories and do everything which may be necessary to carry out the contract in good faith.

1-10. ELECTRICAL ENERGY DURING THE CONSTRUCTION PERIOD.

(a) The United States will provide a source of electrical energy without cost to the contractor at a point approximately 500 feet from the south abutment of the Long Sault Dam Site. The capacity of this source will be approximately 400 K.V.A. for each Section of work at 4,800 volts, 3 phase, 60 cycles. The contractor will provide, without cost to the United States, all facilities and equipment necessary to furnish himself with electrical energy for power, and lighting from the above source. This shall include connecting to a meter and the provision of transformers, poles, switches, lights, and any other equipment that may be necessary. Energy will be 3 phase, 60 cycles, for the operation of all government equipment, (See subparagraph (b) below) furnish at the voltages as required for each specific use or as indicated on the drawings. The contractor shall maintain service until completion of the contract. All costs for electrical energy shall be borne by the contractor. The United States will provide an electric meter at the above mentioned source of power, and the contractor shall make payment to the United States each month for electrical energy furnished him, at the rate of the actual cost to the United States, including installation and overhead, for supplying the electrical energy.

(b) The contractor shall provide for the period of this contract the electrical energy for lighting and miscellaneous use in the portable building required for each section of work (see paragraph 1-21 (e) herein). The contractor shall provide an electric meter in the building, and each month the electrical energy furnished the building, will be deducted from the total electrical energy furnished the contractor. The energy required in the portable building shall be 220/110 volts, 60 cycle, single phase, 3 wires.

1-11. RIGHT-OF-WAY. - The right-of-way for the work covered by these specifications will be that area within the limit of work lines shown on contract drawings and will be furnished by the Government.

1-12. ROADS AND GROUNDS.

(a) The contractor shall have the privilege of using the Government controlled land within work areas shown on sheets No. 32-39 incl. of the drawings, except for that part of said lands as may be reserved by the contracting officer for other purposes.

(b) At any time during the progress of the work the contractor shall, when so directed by the contracting officer, promptly vacate and clean up, within 60 days after written notice, without expense to the Government, any part of the grounds which have been in use by him when such grounds are needed for other purposes. The contractor shall keep the buildings and grounds in use by him at the siteof the work in an orderly and sanitary condition and shall provide suitable extinguishers or other fire-fighting apparatus for ready use in all buildings erected or in use by the contractor on Government property.

(c) The contractor shall not obstruct any existing roads on the lands controlled by the United States except within the bounds of the permanent work shown on the drawings or as otherwise approved by the contracting officer and shall maintain all roads in the vicinity of the work in as good condition as exists at the time of commencement of the work.

1-13. DATUM AND REFERENCE BENCH MARKS. - The plane of reference used in these specifications and on the drawings is Mean Sea Level. Elevations referred to this datum plane are to be determined from the following bench mark; See Bulletin 514, Results of Spirit Leveling in New York. U. S. Geological Survey, page 59.

> Pollys Creek, 420 feet east of.5.5 feet from
> south fence of road, on south side of river
> road on line of a stone fence running north and
> south, opposite barnyard of Frank Polly's farm;
> top of roundheaded brass bolt set in concrete base
> (U.S. Corps of Engineers 4). Elevation 221,378.

1-14. PHYSICAL DATA.

(a) Subsurface Explorations. - Investigations, including surveys, borings, test pits, and probings have been made at the site by the United States to determine the character of the subsurface materials. The location of probings along the canal and all borings are shown on Sheets 5 to 11.

inclusive. The records of these probings and drill holes are shown on Sheets 12 to 31 inclusive. The location and record of all other exploration are on file in the U. S. Engineer Office, Massena, New York.

The United States does not guarantee that other materials will not be encountered nor that the proportions of the several materials will not vary from those indicated by the explorations. Bidders are expected to examine the site of work, the logs of borings, test pits, probings, and samples of which are available at the U. S. Engineer Office, Massena, New York, and after investigation decide for themselves the character of the materials. and make their bids accordingly.

(b) Weather conditions. - Meterological data in the form of rainfall, and snow, and temperature records, prepared from records covering a period of 33 years (1907 to 1939, inclusive) of the U. S. Weather Bureau Station at Canton, New York, approximately 35 miles south-west of the site of the work, are as follows:

| | Temperature Degrees Fahrenheit | | | Precipitation (Mean Monthly) | |
|---|---|---|---|---|---|
| Month | Mean Monthly | Extreme Max. | Extreme Min. | Total Inches | Inches of Snow |
| January | 16.8 | 61 | -41 | 2.64 | 14.9 |
| February | 15.8 | 63 | -43 | 2.30 | 15.5 |
| March | 27.9 | 78 | -30 | 2.60 | 13.1 |
| April | 41.7 | 85 | -1 | 2.59 | 4.9 |
| May | 54.2 | 93 | 21 | 3.03 | 0.2 |
| June | 63.5 | 97 | 30 | 3.51 | 0 |
| July | 68.8 | 99 | 34 | 3.62 | 0 |
| August | 66.5 | 96 | 35 | 3.42 | 0 |
| September | 58;8 | 91 | 25 | 3.44 | 0.1 |
| October | 47.4 | 83 | 14 | 3.04 | 1.0 |
| November | 35.0 | 75 | -15 | 3.02 | 7.5 |
| December | 21.4 | 61 | -37 | 2.62 | 14.5 |

(c) St. Lawrence River Water Temperature. - The St. Lawrence River water temperatures prepared from records covering a period of 8 years (1933 to 1940, inclusive) of the City Engineer, Ogdensburg, New York, are as follows:

| | WATER TEMPERATURE<br>Degrees Fahrenheit | | |
|---|---|---|---|
| Month | Mean Monthly | Extreme Max. | Extreme Min. |
| January | 32.7 | 36 | 32 |
| February | 32.9 | 37 | 32 |
| March | 33.0 | 37 | 32 |
| April | 36.2 | 46 | 32 |
| May | 46.9 | 60 | 37 |
| June | 58.8 | 66 | 49 |
| July | 65.5 | 73 | 59 |
| August | 70.5 | 74 | 63 |
| September | 64.6 | 72 | 59 |
| October | 56.4 | 65 | 50 |
| November | 46.5 | 52 | 37 |
| December | 35.7 | 44 | 32 |

The above data are included for the information of the contractor. The Government assumes no responsibility for their completeness or accuracy or for deductions, interpretations, or conclusions drawn therefrom.

(d) River Stages. - Mean low water of the St. Lawrence River near the mouth of Grass River is at Elevation 154.84. During the period of record 1917 to 1941, the maximum stage occurred at this point on February 1928 which was Elevation 176.4. The water at this point reached Elevation 172.0, 17 times in 7 years during this period. Such high stages are produced by ice conditions in the river downstream from the site of work and are not expected to occur during the period April 16 to November 30. The maximum stage occurring at the aforementioned location during the period of April 16 to November 30, is estimated to have reached approximate Elevation 159. Additional data on river stages are available for inspection in the U. S. Engineer Office, Massena, New York. The Government does not guarantee the completeness or accuracy of any of the above data and assumes no responsibility for deductions, interpretations, or conclusions drawn therefrom.

(e) Utilities. - The United States will make such changes in the power transmission lines shown in the drawings in the vicinity of canal Station 358 - 00 as necessary to prevent interference with the contractors operations. These changes will be completed not later than______________. In the event that other power lines, telephone or telegraph lines, pipe lines, cables, or other utilities are encountered within the limits of the work the contractor shall notify the contracting officer in writing of any necessary changes in such utilities not less than 30 days in advance of the date he desires such changes made. The contracting officer will arrange for the relocation or reconstruction of such utilities by other agencies, or will authorize the contractor to remove them, at no extra cost to the Government, to the extent required for execution of the contract work.

1-15. TRANSPORTATION FACILITIES. - The following information on transportation facilities is furnished for the information of the contractor, but the Government assumes no responsibility for its completeness or accuracy and the contractor is expected to investigate the conditions and determine for himself the probable transportation facilities available.

(a) Railroads. - Massena, New York is served by the New York Central Railroad and a branch line of the Canadian National Railway (known as the Grand Trunk Lines in the United States). Plans are now being developed for a construction railroad to be built by others, such railroad to connect with the existing Massena Terminal Railroad now serving the Aluminum Company Plant. The contemplated railroad will cross the Grass River or the Massena Power Canal and will probably terminate a few miles northeast of Massena, New York.

(b) Highways. - The town of Massena, New York is served by New York State Highways No. 37 and No. 56, the latter connecting with U. S. Highway No. 11 at Potsdam, New York, about 25 miles distant. Several improved county roads connect with the aforementioned State Highways with the site of the work.

(c) Water. - The nearest port to the site of the work providing docking and other harbor facilities is Cornwall, Ontario, Canada. Cornwall is accessible by water from Lake Ontario and from the head of deep-water navigation at Montreal by means of the St. Lawrence Canals and open-river stretches of navigable channels. The upstream end of the Long Sault Canal site (Richards Landing) is accessible by water from Morrisburg, Ontario, Canada, and the lower end (Mouth of Grass River) is accessible by water from Cornwall, Ontario, Canada. Soundings of the St. Lawrence River are available for inspection in the U. S. Engineer Office, Massena, New York, but the indicated depths are not guaranteed by the Government. Locks in the canals generally limit the size of craft to widths less than 45 feet, lengths less than 250 feet, and drafts less than 14 feet. For a detailed description of the existing canals and other lock clearances and depths, the contractor is referred to the booklet "The Canals of Canada," published by the Department of Transport, Ottawa, Ontario, Canada, copies of which are available for inspection in the U. S. Engineer Office, Massena, New York. The navigation season is usually limited by ice conditions to the period from April 20 to December 1.

### 1-16. ORGANIZATION, PLANT AND PROGRESS.

(a) The contractor shall perform, directly and without subcontracting, not less than twenty-five percent (25%) of the work, to be calculated on the basis of the contract price.

(b) The contractor shall employ an ample force of properly experienced men and provide a construction plant properly adapted to the work and of sufficient capacity and efficiency to accomplish the work in safe and workmanlike manner at the rate of progress specified in his bid. All plants shall be maintained in good working order and provision shall be made for immediate emergency repairs. No reduction in the capacity of the plant employed on the work shall be made except by written permission of the contracting officer. The measure of the "Capacity of the plant" shall be its actual performance on the work to which these specifications apply. It is understood that award of this contract shall not be construed as a guaranty by the United States that plant listed in statement of contractor for use on this contract is adequate for the performance of the work.

(c) Should the contractor fail to maintain the rate of progress proposed in his bid, the contracting officer may require that additional men or plant, or both, be placed on the work, working if necessary during additional periods, or a reorganization of plant layout be affected in order that work be brought up to schedule and maintained there. Should the contractor refuse or neglect so to increase the number of men or plant, or both, or to reorganize the plant layout in the manner satisfactory to the contracting officer, the latter may proceed under the provisions of Article 9 of the contract.

### 1-17. LIABILITY AND SAFETY REQUIREMENTS.

(a) Accident Prevention. - In order to protect the life and health of employees in the performance of this contract, the contractor will comply with all pertinent provisions of the "Safety Requirements in Excavation-Building-Construction" approved by the Chief of Engineers, December 16, 1941, (a copy of which is on file in the office of the contracting officer) and as may be amended, and will take or cause to be taken such additional measures as the contracting officer may determine to be reasonably necessary for this purpose. The contractor will maintain an accurate record of and will report to the contracting officer in the manner and on the forms prescribed by the contracting officer, all cases of death, occupational disease and traumatic injury arising out of or in the course of employment on work under this contract. The contracting officer will notify the contractor of any non-compliance with the foregoing provisions and the action to be taken. The contractor shall, after receipt of such notice, immediately correct the conditions to which attention has been directed. Such notice, when served on the contractor or his representative at the site of the work, shall be deemed sufficient for the purpose aforesaid. If the contractor fails or refuses to comply promptly, the contracting officer may issue an order stopping all or any part of the work. When satisfactory corrective action is taken, a start order will be issued. No part of the time lost due to any such stop order shall be made the subject of claim for extension of time or for excess costs or damages by the contractor.

(b) The contractor will not be allowed to block or obstruct any public highway without having secured prior permission from the contracting officer, and having provided safe, temporary detours. During the time the public highway may be so blocked, the contractor shall place danger lights, barricades and warning signs in accordance with the laws of the State of New York.

(c) The contractor shall be responsible that his employees strictly observe the laws of the United States affecting all operations at the site under the contract. He shall comply with all applicable Federal, state and local laws, including those concerning the inspection of boilers and other equipment, the licensing of engineers and other employees.

(d) The United States will not be responsible for any damage to, or increased difficulties in performance of the work under this contract on account of any scow or other changes in the river bed or banks or water currents, and no payments, allowances, or deductions will be made for or on account of any such damage or difficulties.

(e) Nothing in this paragraph shall be construed as modifying the responsibility of the contractor as set forth in Article 10 of the contract.

1-18. LIGHTS. - The contractor shall, at his own expense, display proper lights continuously each night, between the hours of sunset and sunrise and during fogs, upon all floating plant connected with the work, upon all ranges and other stakes in connection with it, when necessary in the opinion of the contracting officer, and upon all buoys of such size and in such locations as to endanger or obstruct navigation, and shall be responsible for all damages resulting from any neglect or failure in this respect. If work is done at night the contractor shall maintain, from sunset to sunrise such lights on or about his plant as the contracting officer may deem necessary for the proper observation of the operations.

1-19. USE OF EXPLOSIVES. - The contractor shall use the utmost care in the use of explosives necessary for the prosecution of the work, not to endanger life or property. All blasting operations shall be conducted by experienced men only. The handling and use of explosives shall be done strictly in accordance with the latest methods and rulings to insure safety; in accordance with the specifications issued by the U. S. Bureau of Mines; and in compliance with the local and state laws. Failure to observe necessary precautions will be sufficient grounds for temporary suspension of the work. All explosives shall be transported and stored in a secure manner and in accordance with local and state laws; all vehicles and such storage places shall be marked clearly "DANGER-EXPLOSIVES", and shall be in the care of competent watchmen at all times. In no case shall caps or other detonators be stored or transported with dynamite or other explosives. The location of magazines for the storage of explosives and for the separate storage of detonators shall be subject to the approval of the contracting officer.

1-20. PROPERTY DAMAGE. - Damage to Government property or to the works due to failure of the contractor to carry out the terms of the contract and specifications, to take reasonable precautions, or to maintain progress to approved schedules, or to carry out the instructions of the contracting officer shall be made good by the contractor without expense to the United States. He will also be held responsible for any damage done to adjoining property through his neglect or failure to take proper precautions (See Article 10 of the contract).

The contractor will not be held responsible for damage sustained by the permanent work from accident, flood, or exposure where such damage is not due to his fault or negligence and where the work is being conducted in accordance with the terms and schedule of the contract and specifications, but he shall make such repairs as the contracting officer may direct to such damaged portions of the work, at the applicable contract unit prices for the various items of work.

1-21. INSPECTION.

(a) The work will be conducted under the general direction of the contracting officer and will be inspected in accordance with Article 6 of the contract by inspectors appointed by him. The inspectors will keep a record of the work done and see that the location and limit marks are kept in proper order, but the presence of the inspector shall not relieve the contractor or his responsible agent (see Article 8 of the contract) of responsibility for the proper execution of the work.

(b) Should the contractor refuse, neglect or delay compliance with the requirements concerning facilities for inspection and layout (see paragraph 1-22), the specific facilities may be furnished and maintained by the contracting officer, and the cost thereof deducted from any amount due or to become due the contractor.

(c) Except as specified in this paragraph, in Article 6 of the contract and in paragraphs 1-22 and 2-10, all expenses of inspection will be borne by the United States.

(d) It is understood that any instructions, or decisions given by a superior officer, through the contracting officer, are to be considered instructions or decisions of the contracting officer, in all cases where, under the terms of this contract, decision rests with the contracting officer.

(e) Portable Building. - The contractor shall furnish a suitable portable building for each section included in the contract, located as required by the contracting officer within the site of the work, for use by the Government. The building shall be approximately 10 feet by 12 feet and shall be supplied with an instrument rack, a built-in-desk, clothes lockers, supply cabinet with loc, bench and such other appurtenances as may be required by the contracting officer. The buildings may be of any type construction approved by the contracting officer and shall be movable, as the contracting officer might require their location to be shifted during progress of the work. They shall be reasonably weather proof, and shall be supplied with heat and electric lights without cost to the Government.

1-22. LINES, GRADES AND MEASUREMENTS. - The work shall be carried out in strict accordance with lines, grades, and dimensions shown on the drawings or as directed from time to time by the contracting officer.

The contractor, shall at his own expense, furnish all stakes, templates, patterns, platforms and special labor that may be required in setting and cutting, or laying out any part of the work.

The contracting officer will furnish the control points, lines, grades, and elevations necessary to enable the contractor to perform the construction work. After this layout has been made by the contracting officer, it shall be the responsibility of the contractor to supply and maintain all additional survey points, grade stakes, and other work lines necessary for the proper execution and conduct of the work.

From time to time during the progress of the work, the contracting officer will check the contractor's lines and grades to determine whether or not the work is being accurately and properly executed, but such checks will in no way relieve the contractor of the responsibility for executing the work in accordance with the plans and specifications, or the original field layout furnished by the contracting officer.

Bench marks, triangulation stations, and principal control points shall be preserved by the contractor wherever possible and in case of their unwarranted destruction or removal by him or his employees, they will be replaced by the contracting officer at the contractor's expense.

1-23. CHANGES AND CHANGED CONDITIONS. - When changes are made in the specifications or drawings, or changed conditions are encountered during the progress of the work, which cause an increase or decrease in the amount due under the contract, or in the time required for its performance, an equitable adjustment shall be made in accordance with Articles 3 and 4 of the contract.

1-24. MINOR MODIFICATIONS. - The right is reserved to make such minor changes in the execution of the work to be done under these specifications as, in the judgment of the contracting officer, may be necessary or expedient to carry out the intent of the contract; provided, that the unit cost to the contractor of doing the work shall not be increased thereby, and no increase in unit price over the contract rate will be paid to the contractor on account of such changes. (see Articles 3, 4, and 5 of the contract).

1-25. CLAIMS, PROTESTS AND APPEALS. - If the contractor considers any work demanded of him to be outside the requirements of the contract or if he considers any action or ruling of the contracting officer or of the inspectors to be unfair, the contractor shall without undue delay, upon such demand, action, or ruling, submit his protest thereto in writing to the contracting officer, stating clearly and in detail the basis of his objections. The contracting officer shall thereupon promptly investigate the complaint and furnish the contractor his decision, in writing, thereon. If the contractor is not satisfied with the decision of the contracting officer, he may, within thirty days, appeal in writing to the Secretary of War, whose decision, or that of his duly authorized representative, shall be final and binding upon the parties to the contract. Except for such protests of objections as are made of record in the manner herein specified and within the time limit stated, in the records, rulings, instructions or decisions of the contracting officer shall be final and conclusive.

All appeals from decisions of the contracting officer authorized under the contract shall be addressed to the Secretary of War, Washington, D. C. The appeal shall contain all the facts or circumstances upon which the contractor bases his claim for relief and should be presented to the contracting officer for transmittal within the time provided therefore in the contract.

1-26. PATENTS. - The contractor shall hold and save the Government its officers, agents, servants and employees, harmless from liability of any nature or kind, including costs and expenses for or on account of any patented or unpatented invention, article or appliance manufactured or used in the performance of this contract, including its use by the Government.

1-27. PROTECTION OF STORED MATERIALS. - All materials, supplies and articles delivered at the site shall be adequately housed or otherwise protected against deterioration and damage to the satisfaction of the contracting officer. When material stored at the site and partly paid for is not adequately protected by the contractor, such material will be kept protected by the contracting officer, at the expense of the contractor and no partial payments will be made upon future delivery of the articles or commodities in question.

1-28. MISPLACED MATERIAL. - Any material that is deposited elsewhere than the place designated or approved by the contracting officer will not be paid for, and the contractor may be required to remove such material and waste it or redeposit it as directed.

### 1-29. PREFERENCE FOR DOMESTIC ARTICLES.

(a) With reference to article 18 of the contract, because the materials listed below, or the materials from which they are manufactured are not mined, produced, or manufactured, as the case may be, in the United States in sufficient and reasonably available commercial quantities and of a satisfactory quality, their use of the work herein specified is authorized without regard to the country of origin.

Platinum
Chromium
Cork
Jute
Kaurigum
Lac
Asphalt
Nickel
Rubber
Teak Wood
Silk
Sisal
Tin
Aluminum
Asbestos
China Wood Oil (Tung Oil)
Balsa Wood
English Ball Clay
English China Clay
Natural Copper-Nickel Alloy
Diamonds

(b) Articles, materials or supplies manufactured in the United States and containing mercury, antimony, tungsten or mica of foreign origin may be used in the work herein specified because of such manufactured articles, materials, or supplies have been manufactured in the United States substantially all from articles, materials, or supplies, mined, produced or manufactured, as the case may be, in the United States.

1-30. INTERFERENCE WITH OTHER CONTRACTS. - The contractor shall not interfere with material, appliances or workmen of the United States or of any contractor who may have work at this site. As far as practicable, all contractors shall have equal rights to the use of all roads, grounds and adjacent river and make equitable agreements among themselves for the use of temporary railroads and highways. In cases of disagreement regarding such use, the decision of the contracting officer shall govern. (see Article 13 of the contract)

1-31. RESTORATION OF SITE. - Before final payment is made, the contractor shall remove from the site, without expense to the United States, all rubbish, unused materials, provided by him, temporary buildings, and other structures erected by him, shall fill all holes or cavities made for his convenience, except as otherwise provided, and shall leave the whole site in good order and condition, all as required by the contracting officer.

1-32. RATE OF WAGES.

(a) Pursuant to the provisions of Article 17 of revised United States Standard Form No. 23 the following wages rates have been determined by the Department of Labor.

SCHEDULE OF WAGE RATES

| Classification | Minimum Rate per Hour |
|---|---|
| Blacksmith | |
| Blacksmith's Helper | |
| Blademan | |
| Blaster | |
| Carpenter | |
| Carpenter's Helper | |
| Mechanic | |
| Mechanic's Helper | |
| Electrician | |
| Electrician's Helper | |
| Fireman | |
| Greasers (any machinery) | |
| Oiler (Dredge) | |
| Oiler (Power Shovel, Dragline & Tower machine) | |
| Operator (Elevating grades) | |
| Operator (Bulldozer) | |
| Operator (Tractor) | |
| Operator (Crane) | |
| Operator (Power Shovel, Dragline & Tower machine) | |
| Operator (Pump) | |
| Operator (Derrick) | |
| Operator (Launch, under 65 H.P.) | |
| Craneman (Dredge) | |
| Deckhand (Dredge) | |
| Laborer (Dredge) | |
| Laborer | |
| Welder (Electric) | |
| Welder (Gas) | |

## SCHEDULE OF WAGE RATES

| Classification | Minimum Rate Per Hour |
|---|---|
| Truck Drivers: | |
| 1½ tons or less | |
| 1½ tons to 4 tons | |
| 4 tons to 10 tons | |
| over 10 tons | |
| Dumpman (spotter and grademen) | |
| Watchman | |
| Painters | |
| Jack Hammer & Drill Operators | |
| Pipefitters (steam) | |
| Plumbers | |

(b) Each class of laborer and mechanic specified in the above schedule shall receive not less than the minimum rate of wages specified therein, except that dedutions from wages paid may be made as required by any laws now or hereinafter in force, in the state in which this project is situated, calling for contribution by employees from earnings to funds maintained in the administration of any unemployment compensation law under the Social Security Act. In the event that it becomes necessary to employ any laborer or mechanic whose work is not covered by any of the classifications in said schedule, he shall be paid not less than the prevailing rate of wages for the class of work done by him. Such rate shall be predetermined by the contracting officer. In case of any dispute arises as to what are the prevailing rates of wages for work of a similar nature which cannot be adjusted by the contracting officer, the matter shall be referred to the Secretary of Labor for determination and his decision thereon shall be conclusive on all parties thereto.

(c) The contractor will be required to furnish identification badges for all his employees. The badges will show the employees photograph, printed name and signature, and will be of a design approved by the contracting officer.

(d) The contractor, in performing the work required by this contract, shall not discriminate against any worker because of race, creed, color or national origin.

(e) The contractor, agrees that the provisions of paragraph (d) above will also be inserted in all of his subcontracts. For the purpose of this article a subcontract is defined as any contract entered into by the contractor with any individual, partnership, association, corporation, estate, or trust, or other business enterprise or legal entity, which involves performance, wholly or in part at the site of the work, of some part of the work to be performed under this contract.

1-33. REPORTS TO DEPARTMENT OF LABOR. - The contractor will report monthly, and will cause all subcontractors to report in like manner, within five days after the close of each calendar month, on forms to be furnished by the Department of Labor, the number of persons on their respective payrolls, the aggregate amount of such payrolls, the man hours worked, and the total expenditures for materials. He shall furnish to the Department of Labor the names and addresses of all subcontractors on the work at the earliest date practicable, provided that the foregoing shall be applicable only to work at the site of the construction project. Copies of all data furnished the Department of Labor shall be promptly furnished the contracting officer.

1-34. INVOICES. - The contractor shall furnish the contracting officer with copies of all invoices for the purchases of materials; supplies and plant in connection with the work to be performed under these specifications. The contractor's records shall be subject to inspection by the contracting officer to verify the accuracy and completeness of the information furnished.

1-35. COST DATA. - The Government will keep a record of the costs of the work performed under these specifications and the contractor shall permit the contracting officer to have access to his timekeeping, invoices, and plant records for this purpose. The contractor shall also furnish the contracting officer with a statement of the initial cost and date of purchase of all plant used in connection with the work.

1-36. ADJUSTMENT OF CONTRACT PRICE BY REASON OF CHANGE IN FEDERAL, STATE OR LOCAL TAXES. - The contract price will be considered to include all Federal, State and local taxes imposed prior to the date of opening bids and applicable to the undertaking. If any privilege, sales, gross receipts or other tax (exclusive of taxes on net income or undistributed profits) applicable to the undertaking and payable directly by the contractor, is imposed or changed after the date of opening bids by Federal or state enactment, then the contract price will be increased or decreased accordingly and any amount due or chargeable against the contractor as a result thereof will be adjusted on payment vouchers as separate items.

1-37. SUBCONTRACTORS. - Subcontractors and their employees shall be considered to be employees of the contractor as the term "employee" is used in these specifications.

1-38. SITE OF WORK. - The term "site of work", as used in these specifications and in Articles 17 and 19 of the contract, will embrace all areas wherein field operations are conducted by the contractor in connection with this contract, including work areas, shops, yards, camps, etc., irrespective of whether such operating areas lie within the limits of work areas or right-of-day shown on the drawings.

1-39. ASSIGNMENT OF CLAIMS. - The Act of October 9, 1940 (Public No. 811, 76th Congress) provides that Sections 3477 and 3737, Revised Statutes shall not apply to any cause in which the moneys due or to become due from the United States, under a contract providing for payments aggregating $1,000 or more, are assigned to a bank, trust company or other financing institution including any Federal lending agency. An assignment may be made under this contract, pursuant to the Act of October 9, 1940, cited above, and subject to the further provisions stated below:

(a) Any assignment shall cover all amounts payable under this contract and not already paid and shall not be made to more than one party, except that any such assignment may be made to one party as agent or trustee for two or more parties participating in such financing.

(b) Any claim under this contract which may be assigned may be subject to further assignment to a bank, trust company, or other financing institution, including any Federal lending agency, and to similar further assignment; provided, that any such assignee shall file written notice of the further assignment together with a true copy of the instrument of further assignment with the contractor and also as provided in proviso 4 of Section 1 of the Assignment of Claims Act of 1940 (Public No. 811, 76th Congress) in respect of original assignment.

(c) No assignee shall divulge any information concerning the contract, or contained therein, except to those persons necessarily concerned with the transaction.

(d) Payments to an assignee of any claim arising under this contract, shall not be subject to reduction of set-off for any indebtedness of the assignor to the United States arising independently of this contract.

## 1-40. ADJUSTMENT OF PRICES FOR LABOR AND MATERIALS.

(a) The following terms used hereafter are defined as follows:

(1) "Basic hourly earnings index" shall be determined by adding month average hourly earnings in the "__________" industry as indicated under heading "__________" in the monthly pamphlet "Hourly Wages and Labor Employment" issued by the Department of Labor for: the month in which contract time commences, the five (5) months preceding such month, and the six (6) months succeeding such month; and then dividing this total by twelve (12).

(2) "Basic materials index" shall be determined by method in (1) above, using month indices for item "______________" in the monthly pamphlet "Wholesale Prices" issued by the Department of Labor.

(3) "Monthly labor adjustment index" shall be determined from monthly average hourly earnings identified as to source in (1) above as follows: Add the average hourly earnings for the month for which adjustment is being made, and two preceding months and the two succeeding months; and then divide this total by five (5).

(4) "Monthly materials adjustment index" shall be determined by method in (3) above, using monthly indices identified as to source in (2) above.

(5) Above contract indices in (1) (2), (3), and (4) shall be computed to nearest second decimal place, taking the decimal point as located in indices issued by the Department of Labor. When third decimal place computes to 5 or over, the figure in second decimal place shall be raised to next higher figure.

(b) (1) The propostion of the contract price represented by labor, subject to adjustment in price, is accepted as____________per cent of contract price.

(2) The proportion of the contract price represented by materials, subject to adjustment in price, is accepted as___________per cent of the contract price.

(c) (1) The labor cost for entire contract as determined in (b) (1) above shall within thirty (30) days after receipt of notice to proceed, be divided into monthly labor cost quotas, prepared by the contractor and subject to the approval of the contracting officer, for each partial or whole calendar month of the contract time beginning with the notice to proceed.

(2) The materials cost for entire contract as determined in (b) (2) above shall be similarly divided into monthly materials cost quotas within thirty (30) days after receipt of notice to proceed.

(d) Adjustments in payments shall be obtained for each monthly cost quota as follows: Multiply monthly cost quota by the appropriate monthly adjustment index, divide by corresponding basis index, and subtract monthly cost quota. The result shall be added to or deducted from payments to the contractor.

(e) (1) If the time for performance of this contract is legally extended by the contracting officer, there shall be immediately set up by the contractor, subject to the approval by the contracting officer, new monthly cost quotas as necessary. These new monthly cost quotas may extend back as far as any month for which adjustments in payments have not been completed, but the total of the new quotas shall not exceed the total of the old quotas for which adjustments in payments have not been completed.

(2) If there is an increase or decrease in the work originally contemplated under this contract, there shall be immediately set up by the contractor, subject to the approval of the contracting officer, new monthly costs quotas for months concerned.

(3) If liquidated damages are assessed against the contractor under the contract, such liquidated damages shall not be considered in making adjustments.

(f) The adjustment payment or deduction for any one month shall normally be included with next partial contract payment after receipt of Department of Labor indices for such month.

(g) The acceptance and final payment for work and/or materials under this contract, shall be carried out as elsewhere provided in this contract, and amounts retained for the protection of the Government during construction shall be promptly paid upon final acceptance: Provided, however, that an amount, as determined by the contracting officer, for protection of the Government in adjustments not yet completed, shall be retained; and, provided further, that the release required by________________ ____________________will contain provision excepting such adjustment payments as may become due the contractor.

(h) After final payment for basic contractural price as indicated in paragraph (g) above has been made, adjustments becoming due will be delayed until all indices necessary for completion of all adjustments under the contract are available, when one lump payment or deduction shall be made for such adjustments.

(i) In case the final adjustment in the contract price results in a net deduction from the contract price, the contractor and his sureties shall be liable for the amount thereof until it is refunded to the Government.

(j) When payment obligations under the contract exceed the contract price as a result of increases in labor and/or materials costs to the extent that available appropriations are exhausted, the Government reserves the right, without further liability to suspend further work under the contract for the account of the Government or to terminate the contract on payment of contractual obligations incurred up to the point of termination.

1-41. FINAL EXAMINATION AND ACCEPTANCE. - When all work called for under this contract has been completed, the contracting officer will make a thorough examination of the same and, if it is found to fully comply with the requirements of the contract, it will be finally accepted and final payment including retained percentages will be made in accordance with the provisions of Article 16d of the contract. Nothing in this paragraph shall be construed as a deviation from the provisions of paragraphs 1-02 (e) and 2-10 regarding the acceptance of subsections.

1-42. APPROVAL. - This contract shall be subject to the written approval of the proper authorities to be designated later and will not be binding until so approved.

## SECTION II

## EXCAVATION OF LONG SAULT CANAL

### 2-01. CHARACTER OF MATERIALS.

(a) Borings and probings made by the United States to determine the character of materials are shown on sheets Nos. 5 to 31, inclusive, of the maps referred to in paragraph 1-04.

(b) Samples obtained from borings and test pits and the logs of test pits are available for inspection at the U. S. Engineer Office, Massena, New York. Previous borings have been made by other agencies in the general vicinity of the work and much of the results of these explorations are also available for inspection in the U. S. Engineer Office. Particular attention is invited to the fact that stones in sizes varying from small gravel to large boulders may be encountered in widely varying proportions in different parts of the work.

(c) The United States does not guarantee that other materials will not be encountered nor that the proportions of the several materials will not vary from those indicated by the explorations. Bidders are expected to examine the site of the work, prior excavations and spoil banks in the general vicinity of the work, the logs and samples from the aforementioned borings, probings, and test pits and after these investigations, plus any additional borings or probings they may desire to make on their own behalf, decide for themselves the characters and proportions of the materials and make their bids accordingly.

(d) If materials, structures, or obstacles of a substantially different character are encountered in the execution of the prescribed work and the cost of their removal or satisfactory treatment obviously would be, in the opinion of the contracting officer, either in excess of, or less than the contract price, the contracting officer, in either alternative, will then proceed in accordance with the provisions of Article 4 of the contract.

### 2-02. CLEARING AND GRUBBING.

(a) The entire work area as shown on the contract plans shall be cleared except buildings required for use by the contracting officer according to the following:

(1) The excavation area for the canal shall be cleared of all trees, brush, fences, buildings and any other objectionable material as directed by the contracting officer.

(2) In areas to be covered by spoil, trees shall be cut off at elevations not higher than 4 feet below the top of the spoil dump.

(3) The foundation areas of the embankments for Class I and Class II compacted earth fills, filter blankets and rock protection shall be cleared and grubbed of all trees, stumps, roots, brush, fences, buildings and any other objectionable material. In foundation areas to be stripped as shown on the contract drawings, all roots 1½ inches in diameter or greater shall be grubbed to a minimum depth of 4 feet below the ground. Trees in the foundation areas for Class III fill shall be cut off at elevations not higher than 2 feet above the ground surface.

(4) All other areas within the limits of the work area not mentioned above shall be cleared of trees, brush, fences, buildings, and any other objectionable material. All trees shall be cut off 2 feet above the ground surface except that above Robinson Bay Lock site no stumps shall remain above

elevation 230 M.S.L. and above Grass River Lock site no stumps shall remain above elevation 192 M.S.L. Where trees stand on ground above these elevations they shall be cut off flush with the ground.

(b) All material from clearing and grubbing shall become the property of the contractor and he shall destroy, remove from the site of the work, or otherwise dispose of it as approved by the contracting officer.

(c) No separate payment will be made for clearing and grubbing, but the cost of doing such work shall be included in the contract prices for other items of work.

## 2-03. EXCAVATION OF CANAL.

(a) General. The contractor shall excavate the Long Sault Canal within the limits and to the lines, slopes and grades indicated on the drawings and as expressed in paragraph 1-02 hereof. The contractor may excavate by dredging (See paragraph 2-03(c) herein) or by land excavation methods or by and combination thereof, excepting within certain reserved areas designated on the plans and referred to herein as areas A consecutively to I. The excavation of these reserved areas shall be done by dry land methods only, and in accordance with the provisions of paragraph 2-04, 2-05, and 2-06. Prior to commencement of work and at intervals of not less than 60 days thereafter during the progress of the work, the contractor shall submit a plan satisfactory to the contracting officer indicating the equipment, methods and procedure he proposes to use in doing the work within the contract time.

(b) Dry Land Excavation not including that involved in the reserved areas A to J may be done by any method the contractor may select providing the excavated material is all deposited within the areas designated as spoil areas in compliance with the provisions of paragraph 2-05. If the contractor prefers to use other or additional spoil areas, he shall first secure the consent of the contracting officer in writing.

(c) Dredging. - In areas where he elects to excavate by dredging, the contractor shall provide all channels, basins, dikes, pumping facilities, waste weirs, and other works required for placing his dredges on the site of the work, create and maintain flotation pools of adequate depth, excavate and dispose of all materials as required herein, and remove his dredges from the site of the work. In connection with all dredging operations, he shall control his waste water so as to avoid damage to the activities of other contractors and the public at large. Location, size and type of waste weirs shall be subject to the approval of the contracting officer. The cost of all such work shall be included in the contract unit prices for excavation. Where the specified side slopes intersect the ground surface at an elevation five feet or more above the dredge flotation pool, the prism of material lying above the pool and at the outer extremity of the slope shall be excavated by dry methods prior to dredging, as indicated on the drawings. Dredging of side slopes shall be conducted so as to produce minimum undercutting. The contracting officer will prescribe the maximum allowable depths of undercutting wherever he considers that the material being excavated is of such nature that slides extending beyond the limits of the specified side slopes might result from excessive undercutting.

## 2-04. EXCAVATION AND DISPOSAL OF MATERIAL FROM RESERVED AREAS.

(a) The following areas designated on the drawings are expected to yield Classes I and II material suitable for the construction of Dikes Nos. 1, 3, 5, and 6 within the limits shown on the drawings, as well as material to be spoiled for subsequent use by the United States.

| Area - | North of Center line of Canal | | South of Center line of Canal | |
|---|---|---|---|---|
| | From Sta. | To Sta. | From Sta. | To Sta. |
| A | 203+00 | 208+00 | 203+00 | 208+00 |
| B | 232+00 | 262+00 | 229+00 | 262+00 |
| C | 267+00 | 291+00 | 267+00 | 290+00 |
| D | 299+00 | 305+00 | 299+00 | 301+00 |
| E | 328+50 | 338+50 | 326+00 | 335+50 |
| F | 348+00 | 354+35 | 345+50 | 354+35 |
| G | 425+00 | 436+50 | 425+00 | 434+00 |
| H | 448+00 | 463+50 | 448+00 | 463+50 |
| I | | | 500+00 | 513+50 |

Serviceable and suitable material from these areas shall be used for the following purposes.

| From Area | Use |
|---|---|
| A | To extent needed in Dike No. 1; excess material to be spoiled in designated spoil areas. |
| B | To extent needed in Dikes Nos. 1 and 3; excess material to be spoiled in compliance with the provisions of paragraph 2-04(b). |
| C | To extent needed in Dikes Nos. 1 and 3. |
| D | In Dike No. 3 to its full extent |
| E | In Dike No. 3 to its full extent |
| F | In Dike No. 3 to its full extent |
| G and H | To extent needed in Dikes Nos. 5 and 6; excess material to be spoiled in compliance with the provisions of paragraph 2-04(b). |
| I | To be stockpiled in compliance with the provisions of paragraph 2-04(b) for subsequent use by the United States. |

(b) The excavation of the foregoing reserved areas shall be done by dry land methods in compliance with the following provisions:

(1) All sod, vegetable matter, soft clay, or other materials which, in the opinion of the contracting officer, are unsuitable for Classes I or II fill shall be stripped and used as Class III fill or deposited in the designated spoil areas in accordance with the provisions of paragraph 2-05.

(2) All material suitable for use shall be hauled immediately to the site of its use, or it shall be stockpiled in the spoil area shown on the drawings in such a manner that it does not become mixed with unsuitable material.

(3) All unsuitable material forming an overburden over usable material shall be stripped off before usable material is dug and conveyed from its present location.

(4) The contractor shall conduct his excavation operations in

such a manner and shall provide such drainage facilities, pumping and dikes as will permit removal of usable material in the driest condition practicable.

(5) Prior to the completion of the dike work required under these specifications, the contractor shall have at all times sufficient plant and equipment available to transport and process into dikes without interruption, the full output of his excavating machines while employed within reserved areas A, B, C, D, E, F, G, and H. During this period he shall proceed to move the suitable material for Class I, and II, fill direct from the excavation to the dikes. If during excavation of the above mentioned reserved areas, weather conditions preclude the proper construction of dikes, the contractor shall cease excavation of the usable material until weather conditions allow dike construction to be resumed, or shall stockpile the usable material in the designated spoil areas (see paragraph 2-04 (b)(2) herein) if so authorized by the contracting officer. Suspension of excavation will be allowed only when and to the extent that in the opinion of the contracting officer progress on the canal excavation has been such as to warrant it. Usable material stockpiled in accordance with the beforementioned requirements shall be re-excavated from the stockpile if needed and transported to the site of dike construction, in which case separate payment will be made therefor at the rate of fifty (50) percent of the contract unit price for original excavation of the material. No such payment will be made for re-excavation of the material stockpiled for any other reasons than those stated herein. If the contractor elects to stockpile in places other than the designated spoil areas during periods when dike construction cannot proceed on account of weather conditions, he may do so under the above provisions for payment for re-excavation provided the site of the contractor's stockpile is approved by the contracting officer. The stockpiling and subsequent rehandling or re-excavation of any material shall not constitute a basis for extension of time limit under the contract.

## 2-05. DISPOSAL OF EXCAVATED MATERIAL.

(a) If the excavation is made by dry land equipment, the following provisions shall apply. The excavated material except as provided in paragraph 2-03 and that required for Class III fill shall be disposed of in spoil piles adjacent to the canal as shown on the drawings. The top of all spoil dumps upstream from Robinson Bay Lock Site shall be at Elevation 234 or lower, or at Elevation 246 or higher, and downstream from Robinson Bay Lock Site they shall be at Elevation 196 or lower, or at Elevation 204 or higher, except that the dimensions, location and the top elevation (258.0) of Spoil Area "K" at the upper end of Section "A" (approximate Canal Station 48+00 to 78+00) shall be as indicated on sheet No. 4. Spoil dumps shall be built so that their front faces will present straight line contours parallel to the spoil control lines indicated on the drawings. The spoil control line is a definite line shown on the plans and cross-sections for the purpose of establishing the position of the front slope at a definite elevation, thus making the front slope a plane surface. All dumps shall be leveled off on top and graded on the side and end slopes to give proper drainage and present an orderly and finished appearance. No dump shall be built with either its front, rear or end slopes steeper than 1 vertical on 3 horizontal. The front slope of dumps shall be kept as uniform as practicable. Gaps in spoil piles for access to the canal and for drainage purposes shall be left at intervals of generally not less than 1000 feet along the canal, and at all other locations shown on the drawings.

(b) If the excavation is done by hydraulic pipeline dredges, the following provisions shall apply:

(1) The dimensions, location and the top elevation (258.0) of Spoil Area "K" (approximate Canal Station 48+00 to 78+00) shall be as indicated

on sheet No. 4

(2) All material dredged from the Long Sault Canal shall be disposed of in accordance with the following provisions. Spoil areas are avail-for the disposal of material within the limits of each section. All dredged materials must be deposited within the designated spoil areas unless specific authority for dumping in other areas is obtained in writing from the contracting officer. If, after the award of the contract, a dumping ground other than those stipulated in these specifications is proposed, its acceptance will be subject to the approval of the contracting officer. No hydraulic spoil area shall be left with any part of its top between the limiting elevations stipulated in subparagraph (a) above. During the life of the contract, the contractor shall confine all dredged material to the designated spoil areas and shall be responsible for all damages which may ensue as a result of the escape of waste water or dredged material incident to his operations from any spoil areas which he may utilize. Whenever practicable, all waste water originating from the operations of the contractor shall be conducted back into the excavation within the limits of his operations. The location of all temporary dikes and waste weirs shall be subject to the approval of the contracting officer. Where the material is deposited in confined areas, all embankments or bulkheads needed for confining or grading the material, with necessary waste weirs, must be provided and maintained by the contractor, and the cost thereof shall be included in the contract unit prices. In all pipeline dumps, the fill shall be so made as to be reasonably free from mounds, ridges or depressions and the grade thereof shall be such as to avoid collecting points for water. The filling of any spoil area shall proceed continuously as far as possible. Under no circumstances, shall any dredged material be permitted to run or spread into the St. Lawrence River except in areas shown on sheet No. 5. No natural water courses shall be obstructed without measures satisfactory to the contracting officer being taken by the contractor. The contractor shall provide any necessary drainage facilities to drain water pockets formed by his operations.

## 2-06. OVERDEPTH AND SIDE SLOPES.

(a) To cover inaccuracies of the excavation work material actually removed within the specific areas to be excavated to a depth of not more than one foot below the required depth will be estimated and paid for at the applicable contract price.

(b) Material actually removed, within limits approved by the contracting officer, to provide for final side slopes as specified herein or as modified by the contracting officer, but not in excess of the amount originally lying above this limiting side slope, will be estimated and paid for. In computing the limiting amount of side slopes excavation an overdepth of one foot measured vertically, will be used. Material taken from beyond the limits above described will be deducted from the total amount excavated as excessive overdepth excavation or excessive side slope excavation, and will not be paid for. Nothing herein shall be construed to prevent payment, under the provisions of paragraph 2-11, for the removal of slides within the limits of excavation prescribed herein.

## 2-07. METHOD OF MEASUREMENT.

(a) The material to be paid for by the cubic yard under the contract will be measured in place by computing the volume between the ground surface shown by the last survey made before excavation and the bottom and side slope surfaces shown by a survey made as soon as practicable after the work specified in each subsection in paragraph 1-02 has been completed.

(b) The maps already prepared are believed to represent accurately average existing conditions but the topography at the site of the work will be verified and corrected by surveys made prior to commencement of work in each area. Determination of quantities removed and the deductions made therefrom to determine quantities by place measurement to be paid for in the area specified, after having once been made, will not be reopened, except on evidence of collusion, fraud, or obvious error.

(c) Monthly partial payments will be based on approximate quantities determined by surveys, soundings or sweepings made after excavation operations.

(d) Excessive overdepth dredging and excessive side-slope dredging will in all cases be excluded as provided in paragraph 2-06.

2-08. EQUIVALENT MEASUREMENTS. - When necessary for any cause to convert "scow measurement" into "place measurement," or the reverse, ten yards of the former will be taken as the equivalent of nine yards of the latter.

### 2-09. WORK COVERED BY THE CONTRACT PRICES.

(a) Payment for all required excavation will be made at the applicable contract unit price per cubic yard for "Excavation; Long Sault Canal".

(b) The contract unit prices for excavation shall cover the cost of removal and disposal of all materials within the limits of excavation indicated on the drawings, except at provided below.

(c) Where rock fragments or boulders, of such size as in the judgment of the contracting officer cannot be removed by the plant stated in the contractor's bid, are encountered within the specified limits of excavation in the canal sections, they may be disposed of by burying in the bottom of the canal to a depth not less than four feet below the specified grade, but no separate payment will be made for the additional excavation or extra work required for such disposal.

(d) The contract unit prices for excavation shall also include the cost of any necessary excavation, embankment construction, or other work required to lock or float a dredge to or from the site of the work. The location and dimensions of any cut embankments or other works so made will be subject to the approval of the contracting office. (See subparagraph 2-03(c).)

### 2-10. ACCEPTANCE.

(a) As soon as practicable after the completion of any subsection established in paragraph 1-02 as in the opinion of the contracting officer will not be subject to injury by further operations under the contract, such subsection will be examined thoroughly by surveys, sounding, sweeping, or by a combination of these methods, as deemed advisable by the contracting officer. Should any shoals, lumps, or other lack of required cross-section be disclosed by this examination, the contractor will be required to remove them, at the applicable contract rate for excavation, but if the bottom is soft and the shoal areas are small and form no material obstruction to navigation, the removal of such material may be waived, in the discretion of the contracting officer. The contractor or his authorized representative will be notified when surveys, soundings and/or sweepings are to be made, and will be permitted to accompany the survey party. When the area is found to be in a satisfactory condition, it will be accepted finally. Should more than two sweeping operations by the United States over an area be necessitated by reason of work for the removal of shoals disclosed at a prior sweeping, the cost of such third and any subsequent sweeping operations will be charged against the contractor at the rate of $50.00 per day for each day or part thereof in which the United States sweeping plant is engaged in sweeping and/or is en route to or from the site or held at or near the said site for such operations.

(b) Final acceptance of the whole or a part of the work and the deductions or corrections of deductions made thereon will not be reopened, after having once been made, except on evidence of collusion, fraud, or obvious error, and the acceptance of a completed section shall not change the time of payment of the retained percentages of the whole or any part of the work stated in paragraph 1-02.

2-11. SLIDES. - Any slides occurring in a subsection of work prior to its acceptance shall be removed to the lines and grades directed by the contracting officer. If such slides occur through no fault of the contractor, the work of removal and disposal of slide materials will be paid for at the applicable contract unit prices for excavation. If the slides occur as a result of excessive undercutting of banks or any other fault of the contractor, as determined by the contracting officer, the slide materials shall be removed and disposed of without extra cost to the United States. If, before the contract is completed, slides occur in any subsection of work previously accepted, removal and disposal of the slide materials at the applicable contract unit prices for excavation may be done if agreeable to both the contractor and the contracting officer.

## SECTION III

## DIKE EMBANKMENTS

3-01. DEFINITION. - The term "embankments" as used in this section includes Class I and Class II compacted earth fill, Class III fill, sand and gravel backing, riprap protection and filter blankets of dikes Nos. 1, 3, 5, and 6 which form a part of this contract.

3-02. GENERAL PROVISIONS.

(a) Lines and Grades. - The embankments shall be constructed to the lines and grades shown on the drawings or otherwise required by the contracting officer. The contracting officer reserves the right to change the foundation widths, change the slopes and dimensions of the embankments, change the dimensions and slopes of the foundation cut-off trenches and change the shape and thickness of the dumped riprap protection and make such other dhanges as future studies and conditions on the work indicate as necessary for the construction of a safe and permanent structure as determined by the contracting officer. Changes in quantities of materials resulting from changes in sections shall be no cause for claims of increased contract unit prices.

(b) Materials. - Materials for the various sections of the embankment shall conform to the respective requirements specified in the following paragraphs of this section. No brush, roots, sod and perishable or objectionable materials, as determined by the contracting officer, shall be placed in the Class I and Class II compacted earth fills. Any objectionable material placed in the embankments shall be removed by the contractor as directed by the contracting officer, without cost to the Government. The suitability of each part of the foundation for placing embankment materials thereon and of all materials for use in an embankment will be determined by the contracting officer. No materials shall be placed in Class I and Class II compacted earth fill when either the materials or the foundation on which they are to be placed is frozen.

(c) Conduct of the Work. - The contractor shall at all times maintain the embankments in conformity with paragraph 3-06 and 3-07 and in a manner satisfactory to the contracting officer until the final completion and acceptance of all work under the contract. The contractor may be required to suspend work at any time when, in the opinion of the contracting officer, satisfactory work cannot be done on account of rain, floods, cold weather, or other unsatisfactory conditions. Any approved embankment material which is lost or rendered unsuitable after being placed in an embankment and before the completion and final acceptance of work, due to causes that, in the opinion of the contracting officer, are avoidable, or under the control of the contractor, shall be replaced by the contractor in a manner satisfactory to the contracting officer and without cost to the Government. The contracting officer may require the contractor to remove without cost to the Government any material placed by the contractor outside of specified slope lines.

(d) Order of Work. - The contractor shall be required to organize the work so that suitable earth fill materials, obtained from the excavation for the canal may be placed directly in the dike embankments in the sections stated in paragraph 2-04. Sections of embankments to be placed on clay foundations shall be constructed so that the surface elevations will be approximately the same over their entire lengths. Gaps shall be left in the embankments at the locations indicated on the drawings or as directed by the contracting officer.

## 3-03. CLEARING AND GRUBBING.

(a) General. - The foundation areas of the embankments are to be cleared and grubbed as stated in paragraph 2-02

## 3-04. REMOVAL AND DISPOSAL OF FOUNDATION EXCAVATION

(a) Excavation. - Embankment areas shall be stripped and excavated to lines and grades, and slopes as shown on the contract drawings or as directed by the contracting officer. The contractor shall de-water all excavation areas to produce a dry condition suitable for placing embankment as determined by the contracting officer. Should excavation be required to a higher or lower elevation than that indicated on the drawings, as determined by the contracting officer, no change will be made therefore in the contract unit prices.

(b) Disposal. - Material excavated from foundation areas for the embankments and determined suitable by the contracting officer for Class I and Class II compacted fill shall be placed directly in the embankments. All other material excavated shall be placed in the Class III fill or in spoil areas as directed by the contracting officer.

(c) Measurement and Payment. - A survey of the ground surface will be made prior to commencement of work, and measurements of stripping and excavation will be made between the ground surface determined by this survey and the excavation lines directed by the contracting officer. Where stripping only is required, the minimum depth will be 1 foot. Payment for all required excavation and stripping in the foundation areas of the embankments shall include the cost of excavation, transporting and disposal and will be made at the contract unit price per cubic yard for "Stripping, Dike Foundation."

## 3-05. PREPARATION OF FOUNDATON FOR EMBANKMENT.

(a) General. - The foundations for the embankments shall be stripped and excavated as specified in paragraph 3-04. The test pits, stump holes and other excavated areas, depressions, and cavities within the limits required to be stripped shall be filled with compacted earth as directed by the contracting officer. The earth fill shall be placed in layers moistened and compacted in accordance with paragraph 3-06. As the fill is brought up, the side slope of the cut or hole shall be scarified, if in the opinion of the contracting officer, it is required, in order to provide a bond between the fill and the original ground material. The sides of all holes shall be broken down if necessary so as to flatten out the slopes, and the hole then filled with approved material and properly rolled or tamped in place. Immediately prior to placing materials in the embankments, the entire foundation except for Class III fill and areas to be covered by sand and gravel filter, shall be scarified to a depth of 4 inches. A 4-inch layer of embankment material shall be spread and compacted as specified for Class I compacted fill in paragraph 3-06. The foundation upon which fill is placed shall be in a suitable dry condition, as determined by the contracting officer.

(b) Measurement and Payment. - Payment for the fills in the foundation areas indicated above, including the spreading, rolling and wetting where required will be made at the contract unit price per cubic yard for "Earth Fill; Compacted, Class I","Earth Fill; Compacted Class II." No payment as a separate item will be made for other work necessary for the preparation of the foundation including the de-watering of the foundation areas of the embankments but the cost of these items shall be included in the contract unit prices for the other items of work connected with the embankments.

### 3-06. CLASS I AND CLASS II COMPACTED EARTH FILLS.

(a) Material. - Materials for the Class I and Class II compacted earth fills shall be secured from the excavations for the canal (see paragraph 2-04) and for the embankment foundations. The materials in general will be a well graded clayey or silty gravelly sand. No stones which would be retained on a 6-inch screen will be permitted in the Class I compacted earth fill. No stones which would be retained on an 8-inch screen will be permitted in the Class II compacted earth fill. Should stones of such size be found in the otherwise approved materials, they shall be removed by the contractor. Suitable stone removed may be used for riprap as specified in paragraph 3-10. Each load of material to be placed in either Class I or Class II compacted earth fill shall be the equivalent, as nearly as practicable, of a mixture of materials obtained from an approximately uniform strip or cutting from the full height of a lift in excavation. The combined excavation and embankment placing operations shall be such that the materials when compacted in the fill will be blended sufficiently to secure the greatest homogeneity and desired density.

(b) Placement. - The distribution and gradation of materials throughout the Class I and Class II compacted earth fill sections of the embankments shall be such that the embankments will be free from lenses, pockets, streaks or layers of materials differing materially in texture or gradatuion from the surrounding materials. The dumping of successive loads of fill materials from the different parts of the required excavations shall be at locations in the embankment as directed by the contracting officer, and for this purpose, the contracting officer may direct the points in the embankments where individual loads of material shall be deposited to the end that the more pervious material shall be placed in the outer exposed sections of the Class II compacted earth fill. After dumping, the materials shall be spread by bulldozers or other approved methods in approximately 8-inch layers over the prepared foundation or fills. Materials in areas where compacting by rolling is impracticable, as determined by the contracting officer, shall be spread in layers 4 inches in thickness before compacting. All layers shall extend at an approximately uniform elevation over the width of the embankment and for the entire length of the section under construction unless otherwise directed by the contracting officer. The top surfaces of the Class I and Class II compacted earth fills during construction shall be kept crowned with grades not less than 2 nor more than 4 percent, so that the surface of the fill will drain freely toward the slopes. If work is stopped on any part of the Class I compacted earth fill for a period of time, the area to remain standing shall be rolled with a smooth-faced roller to prevent loss of moisture and to facilitate drainage. If, in the opinion of the contracting officer, the rolled surface of any layer of any section is too smooth to bond properly with the succeeding layer or adjacent section, it shall be roughened or loosened by scarifying to the satisfaction of the contracting officer before the succeeding layer is placed thereon. Ruts in the surface of any layer shall be filled in a manner satisfactory to the contracting officer.

(c) Moisture Control. -

(1) The materials in each layer of the Class I and Class II compacted earth fills while being compacted shall contain moisture within a few percent of the optimum, as determined by the contracting officer, for the compaction desired. Prior to and during construction, the contracting officer will establish the limiting ranges of moisture contents for materials to be compacted in Class I fill and Class II fill. The moisture content shall be uniform throughout the layer. If the application of water is necessary, it may be done either at the excavation area or at the embankment. Wetting at the excavation area shall be supplemented as required by sprinkling in place on the embankment, if in the opinion of the contracting officer it is necessary. The contractor shall maintain adequate facilities to provide the amount of water required.

(2) No layer of material shall be placed if the moisture content of the exposed surface on which it is to be placed is not within the range established by the contracting officer. The contractor shall correct the moisture content of the compacted layer if the moisture content is not within the required limits.

(d) Compaction. - Class I and Class II compacted fill shall be rolled and compacted with the equipment listed in paragraph 3-06(e) below. Each layer of Class I fill shall be compacted by not less than 6 passes or trips, and each layer of Class II fill shall be compacted by not less than 2 passes or trips of a sheepsfoot roller. In areas where rolling operations are impracticable as determined by the contracting officer, compaction shall be obtained with power tampers of a type approved by the contracting officer to give compaction equal to that required for the adjoining compacted earth fill. Each pass of a roller shall overlap the adjacent rolled area by at least 2 feet. If the moisture content is greater or less than that required for compaction, the rolling or tamping shall be delayed until the proper moisture content as determined by the contracting officer has been reached.

(e) Equipment for Compaction by Rolling. - Equipment consisting of an oscillating double section sheepsfoot tamper roller, pulled by a crawler type tractor weighing not less than 20,000 pounds and which is weighted or equipped with a bulldozer, or both, to increase its total weight to not less than 29,000 pounds, shall be used for compacting Class I fill. The use of more than 2 rollers in tandem will not be permitted. The design and operation of the compacting equipment shall be subject to the approval of the contracting officer. The speed of the compacting equipment shall be not more than 2½ miles per hour. Each drum of the oscillating double section sheepsfoot tamper roller shall be approximately 4 feet in width and shall have tamping feet uniformly staggered over its cylindrical surface and be provided with cleaners. Each tamping foot shall project approximately 7 inches from the roller's cylindrical surface and at no time during operation shall have a face area less than 5 nor more than 7 square inches. The spacing shall be such as to provide not less than 1½ tamping feet for each square foot of cylindrical surface. The sheepsfoot roller shall be weighted so that the total weight of the roller and ballast in pounds divided by the total areas of the maximum number of tamping feet in one row generally parallel to the axis of the roller shall provide for a range of 250 to 400 pounds per square inch by varying the roller ballast.

(f) Tests for Compaction. - Samples for testing of all materials in the embankments, both before and after placement and compaction, will be taken by the contracting officer at frequent intervals. Corrections, adjustments, and modifications of methods may be required as the result of these tests, for materials, moisture content, or additional compaction of the materials in the embankment. In taking samples for control and record purposes, the contractor shall supply labor required to assist the inspector, as directed by the contracting officer. During the construction of the embankments, it may be necessary for the contractor as directed by the contracting officer to construct test embankments which will form part of the completed fill to determine the number of passes or moisture content necessary to obtain the desired compaction.

(g) Additional Compaction. - If the tests specified above indicate that the desired compaction of the materials in the Class I compacted earth fills is not secured by the compaction specified in paragraph 3-06(d), additional compaction may be required by the contracting officer. Additional compaction shall consist of making not less than 2 passes of a sheepsfoot roller specified in paragraph 3-06(e) over such designated areas. Each 2 passes of the roller shall overlap the adjacent rolled area by at least 2 feet. This procedure will be repeated as often as is necessary to obtain the desired compaction.

(h) Measurement and Payment.

(1) Measurement of Class I and Class II compacted earth fills placed in the embankments, will be made between the lines indicated on the drawings and the required stripping or excavation lines. Measurement of settlement will be made between the foundation line after stripping or excavation and a survey of settlement plates at time of acceptance (see paragraph 3-13). Payment for Class I and Class II compacted earth fill will be made at the contract unit price per cubic yard for "Earth Fill, Compacted, Class I" and "Earth Fill, Compacted, Class II", which payment shall include all incidental work specified or required such as transporting and spreading, mixing, scarifying, harrowing, moistening, drying, compacting, removing oversize stones, objectionable materials, furnishing laborers for sampling and constructing test embankments. Payment for fill due to foundation settlement will be included in the final payment for embankment.

(2) Payment for each additional two passes of a roller as required by the contracting officer will be made at the contract unit price per square (100 sq. ft.) for "Additional Compaction."

## 3-07. CLASS III FILL.

(a) General. - Material for Class III fill shall be secured from the required excavations for the canal and foundations. The material except in the upper 3 feet on the pool side shall be any material as approved by the contracting officer in excess of that required or not satisfactory for Class I and Class II compacted fill and may contain boulders, stones, sod, and strippings, providing they are embedded, satisfactory to the contracting officer. The material in the upper 3 feet on the pool side shall be well graded, clayey or silty gravelly sand and shall be free from sod, stripping, roots and other perishable or bouyant materials. Class III fill may be placed in layers of a thickness not to exceed 5 feet. The layers shall extend at approximately uniform elevation over the entire length and width of the fill and at no time shall the top of the fill be above the surface elevation nor more than 6 feet below the Class II fill.

(b) Measurement and Payment. - Measurement for Class III fill placed in the embankments will be made between the slope lines indicated on the drawings and the original surface. Measurement of settlement will be made between original ground surface and survey of settlement plates at time of final acceptance (see paragraph 3-13). Payment for Class III fill placed in the embankments will be made at the contract unit price per cubic yard for "Class III Fill" which payment shall include all incidental work specified or required such as transporting, spreading, and maintaining the surface for satisfactory operations. Payment for fill due to foundation settlement will be included in final payment of embankment.

## 3-08. FILTER.

(a) General. - Filters shall be constructed in 12 inch layers at the locations and to the lines and grades shown on the drawings, or at such other locations as may be required by the contracting officer. Each 12 inch layer shall be compacted by covering the entire area with one pass of tractor tread. The material shall conform to the requirements specified in the following paragraph and, if practicable during construction, shall be kept to the same height as the adjacent fill material. Any material encountered in the required excavation that meets the requirements of paragraph 3-08(b) may be used for the filter. Additional materials required for the filter not obtainable from required excavation shall be obtained from other sources by the contractor.

(b) Filter Material. - The material for filters shall be well graded sand, or sand and gravel, which after placement, shall contain at least 40 percent by weight which will pass the 1/4-inch mesh screen and no stones shall be larger than 6 inches. Of the material passing the 1/4-inch screen, at least 80 percent by weight shall pass a No. 10 mesh screen, and not more than 10 percent shall pass the No. 200 mesh screen. Samples of the material the contractor proposes to use shall be submitted to the contracting officer at least 30 days prior to the date that the contractor plans to commence placement of filter.

(c) Measurement and Payment. - Measurement of filter material will be made between the lines indicated on the drawings, or as modified by the contracting officer. Payment for furnishing and placing filter material, regardless of source will be made at the contract unit price per cubic yard for "Filter".

## 3-09. SAND AND GRAVEL BACKING.

(a) General. - Sand and gravel backing for riprap on slopes shall be constructed to the lines and grades shown on the drawings. During construction the placing shall be kept at substantially the same level as the compacted earth fill. Any material encountered in the required excavation that meets the requirements of paragraph 3-07(b) may be used for sand and gravel backing. Additional materials required for the filter not obtainable from required excavation shall be obtained from other sources by the contractor.

(b) Material. - Material for sand and gravel backing shall consist of bank run sand and gravel of which the material after placement shall contain from 30 to 60 percent by weight retained on the 1/4-inch mesh screen, and no stones shall be larger than 6 inches. Of the material passing the 1/4-inch mesh screen, not more than 20 percent shall pass the No. 200 mesh screen. Samples of proposed material shall be submitted as stated in paragraph 3-08(b).

(c) Measurement and Payment. - Measurement of sand and gravel backing material will be made between the lines indicated on the drawings, or as modified by the contracting officer. Payment for furnishing and installing backing material, regardless of source, will be made at the contract unit price per cubic yard for "Sand and Gravel Backing."

## 3-10. RIPRAP.

(a) Classification. - All rock for the riprap protection of the embankments shall be clean, sound and durable, and as approved by the contracting officer. It shall be obtained from the required excavation material or other sources approved by the contracting officer. Shale and other rock which, in the opinion of the contracting officer, will not endure frost action shall not be used. This riprap shall consist of stones weighing in general not over 250 pounds, of which not more than 10 percent of the whole shall be formed of pieces weighing less than 15 pounds which shall be well distributed throughout the mass.

(b) Placement. - Riprap shall be dumped in the sections to the line and grades shown on the drawings or as directed by the contracting officer. The different sizes of stone shall be well distributed within the section. Care shall be taken in dumping and placing not to disturb the underlying fill. The riprap shall be placed in approximately horizontal layers not exceeding 3 feet in thickness, and shall be kept substantially the same level as the surface of the earth fill. In all final surfaces, such placing of the finished rock surface will be required as will insure a reasonably smooth and continous surface to the slope lines shown on the drawings or as modified by the contracting officer. At the end of a working season for placing earth fill, the riprap sections shall completely cover the finished slopes within the limits specified.

(c) Measurement and Payment. - Measurement for riprap will be made in the embankments only between the lines shown on the drawings or as modified by the contracting officer. Payment will be made for the riprap at the contract unit price per cubic yard for "Riprap" which will include payment for furnishing and selection of materials, hauling, placing and all other work required for the completion of the riprap sections in accordance with these specifications.

### 3-11. SEEDING.

(a) Preparation of Seed Bed.

(1) The areas indicated on the drawings or required by the contracting officer shall be seeded. All areas to be seeded, prior to fertilizing and seeding, shall be harrowed or raked until the soil has become loosened and pulverized. All sticks, litter, roots, weeds, stones larger than 1 inch in diameter and other objectionable materials shall be removed to a depth of 2 inches. The surface of all seed areas shall be trimmed and raked to conform to finished grades, after which the soil shall be fertilized as specified below. Immediately before sowing the seed, the surface of the seed bed shall be sprinkled, if necessary, and raked to a depth of 3/4 of an inch. The raking shall be done in a direction parallel to the contour lines of the slopes (not uphill or downhill).

(2) Method of Fertilizing. - Prior to seeding, fertilizers shall be uniformly spread in a manner satisfactory to the contracting officer. The seed beds shall be fertilized with 1,000 pounds of 20% superphosphate, and 200 pounds of sulfate of ammonia to the acre. In place of the superphosphate, 330 pounds of T.V.A. metaphosphate to the acre may be used.

(b) Seeding. - The quantity and types of seeds specified below shall be sown on prepared seed beds in a manner satisfactory to the contracting officer. The mixtures shall be sown at the earliest date possible between May 1 and September 1. The seed mixtures shall be sown by a mechanical hand seeder or drill. Whenever practical, the mixtures shall be sown in two applications, one-half the seed while the sower is travelling in one direction, and the other half sown while travelling at right angles to the first. The oats or rye shall be sown separately and prior to the remainder of the seed mixture. If oats or rye are sown on the surface, the seeds shall be covered by raking to a depth from 1 to 1½ inches unless the oats or rye are sown with a drill. After all the seed is sown, the seed bed shall be lightly raked with iron rakes, and then rolled with a lawn roller in a manner satisfactory to the contracting officer.

(1) Seed Mixture. - The seed mixtures shall consist of the seeds specified in the table below. When directed by the contracting officer, the seed mixtures may be varied to suit special conditions of soil peculiar to the areas to be seeded. The seed furnished shall be of the previous year's crop and in no case shall the weed content exceed 1% by weight.

Seed Mixture for Seed Bed not Containing Topsoil

| Kind of Seed | % Purity | % Germination | Amount lbs. per acre |
|---|---|---|---|
| Sweet Clover | 99 | 85 | 5 |
| Alfalfa | 98 | 85 | 2 |
| Black Medic | 95 | 80 | 1 |
| Orchard Grass | 97 | 90 | 3 |
| Timothy | 98 | 85 | 3 |
| Redtop | 98 | 90 | 4 |
| Ladino Clover | 97 | 90 | 1 |
| | | | 19 |
| Oats (Seeding prior to July 15), or | 99 | 90 | 30 |
| Rye (Seeding after July 15) | 99 | 90 | 35 |

(2) Inoculation. - The alfalfa, black medic, sweet clover, and ladino clover seeds shall be inoculated with pure cultures of nitrogen fixing bacteria. Inoculants shall consist of pure bred soil or sand cultures, not more than one year old, and shall meet the approval of the New York State Department of Agriculture and Markets. The inoculants shall be mixed with the seed according to the vendor's instructions. After the mixture is dried, it shall be mixed with the grass seeds. All mixing, drying and storing shall be done in the shade. The seed mixture shall be applied to the seed bed within 72 hours after the legume seeds are inoculated.

(c) Maintenance and Reseeding. - The contractor shall maintain the areas sown with the above seed mixture until all work on the contract has been completed and accepted by the contracting officer. The maintenance shall consist of refilling rain washed gullies, reseeding, mowing, watering during periods of drought, and other similar operations when required by the contracting officer. The contractor may, if he desires, protect slopes against erosion until seeding becomes established by spreading on the surface about four tons of straw to the acre.

(d) Measurement and Payment. - Measurement for seeding will be made by the acre for the area within the line shown on the drawings or as modified by the contracting officer. The contract unit price shall include payment for all work in connection with furnishing and sowing all necessary seed, raking and rolling the seeded areas, preparing the seed beds, furnishing and placing all necessary fertilizer, and maintaining all seeded areas. Payment for seeding all seed beds will be made at the contract unit price per acre for "Seeding."

3-12. PROTECTION OF SETTLEMENT GAGES, PIEZOMETERS, AND PRESSURE CELLS. - In order to enable measurements and observations to be made during and after construction of the work required under the contract, the Government will install with its own forces a number of devices in and on the dike fills to consist of settlement plates and gages, piezometers, and pressure cells. The contractor shall conduct his operations in such a manner that these devices and appurtenances will not be damaged. Fill around pipes and bars installed in and on the dike fills shall be placed and compacted by the contractor to the density of the surrounding compacted fill in the manner specified in paragraphs 3-06 and 3-07 herein. Separate payment will not be made for such protection and special measures required in connection with settlement gages, piezometers, and pressure cells and their appurtenances installed by the contracting officer.

3-13. DETERMINATION OF FOUNDATION SETTLEMENT. - For the purpose of determining the settlement of the foundation prior to the acceptance of the work by the contracting officer, the contracting officer will install settlement gages on the clay foundations between the following stations:

| | |
|---|---|
| Dike No. 1 | Station 0+00 to Station 33+00 |
| Dike No. 1 | Station 60+00 to Station 76+00 |
| Dike No. 3 | Station 0+00 to Station 19+50 |
| Dike No. 3 | Station 50+00 to Station 56+50 |

If the contractor so desires to install settlement plates in other areas than those mentioned above, he may do so at his own expense. The settlement plates installed by the contractor shall be approved by the contracting officer, and record of these plates will be kept by the contracting officer. The settlement as determined by all of the gages will be used to compute the settlement of the foundation surface. The elevation of the foundation surface at the time of acceptance of the work will be used to measure the quantity of embankment fill placed by the contractor except in those areas where gages are damaged or lost due to the fault of the contractor.

Long Sault Canal                                                    Invitation No.

# STANDARD GOVERNMENT FORM OF BID
(Construction Contract)

_______________

(Place)_______________

(Date) _______________

To: The District Engineer,
U. S. Engineer Office,
Massena, New York.

1. In compliance with your invitation for bids dated_______________ _____and subject to all the conditions thereof, the undersigned,

_______________________________________________,

a corporation organized and existing under the laws of the State of

_______________________________________________,

a partnership consisting of _______________________________

_______________________________________________

_______________________________________________

or an individual trading as _______________________________

_______________________________________________

of the city of _______________________________

hereby proposes to furnish all plant, labor, and materials and perform all work required for the construction of the Long Sault Canal, at the locations shown and to the extent indicated, in strict accordance with the specifications, schedules, and drawings, for the consideration of the following prices:

## "SCHEDULE OF BID ITEMS"

### Section A

| Item No. | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 1. | Excavation; Long Sault Canal | C.Y. | 3,507,000 | | |

Total . . . . . . . . . . . .$______

### Section B

| Item No. | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Excavation; Long Sault Canal | C.Y. | 5,458,000 | | |
| 2 | Earth Fill; Compacted, Class I | C.Y. | 161,000 | | |
| 3 | Earth Fill; Compacted, Class II | C.Y. | 1,315,000 | | |
| 4 | Earth Fill; Class III | C.Y. | 1,621,000 | | |
| 5 | Additional Rolling | Square (100sf) | 50,000 | | |
| 6 | Stripping; Dike Foundations | C.Y. | 169,000 | | |
| 7 | Riprap | C.Y. | 171,000 | | |
| 8 | Filter | C.Y. | 28,000 | | |
| 9 | Sand and Gravel Backing | C.Y. | 30,000 | | |
| 10 | Seeding | Square (100sf) | 8,700 | | |

Total . . . . . . . . . . . .$______

SCHEDULE (continued)

## Section C

| Item No. | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Excavation; Long Sault Canal | C.Y. | 6,704,000 | | |
| 2 | Earth Fill, Compacted, Class I | C.Y. | 75,000 | | |
| 3 | Earth Fill; Compacted, Class II | C.Y. | 77,000 | | |
| 4 | Earth Fill; Class III | C.Y. | 25, 000 | | |
| 5 | Additional Rolling | Square (100sf) | 25,000 | | |
| 6 | Stripping; Dike Foundations | C.Y. | 38,000 | | |
| 7 | Riprap | C.Y. | 22,000 | | |
| 8 | Filter | C.Y. | 7,000 | | |
| 9 | Sand and Gravel Backing | C.Y. | 3,000 | | |
| 10 | Seeding | Square (100sf) | 1,500 | | |

Total . . . . . . . . . . . . . . .$

## Combination of Section A and B

| Item No. | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Excavation; Long Sault Canal | C.Y. | 8,965,000 | | |
| 2 | Earth Fill; Compacted, Class I | C.Y. | 161,000 | | |
| 3 | Earth Fill; Compacted, Class II | C.Y. | 1,315,000 | | |
| 4 | Earth Fill, Class III | C.Y. | 1,621,000 | | |
| 5 | Additional Rolling | square (100sf) | 50,000 | | |

SCHEDULE (continued)

## Combination of Section A and B (continued)

| Item No. | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 6 | Stripping; Dike Foundations | C.Y. | 169,000 | | |
| 7 | Riprap | C.Y. | 171,000 | | |
| 8 | Filter | C.Y. | 28,000 | | |
| 9 | Sand and Gravel Backing | C.Y. | 30,000 | | |
| 10 | Seeding | square (100sf) | 8,700 | | |

Total . . . . . . . . . . .$__________

## Combination of Section A and C

| Item No. | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Excavation; Long Sault Canal | C.Y. | 10,211,000 | | |
| 2 | Earth Fill, Compacted, Class I | C.Y. | 75,000 | | |
| 3 | Earth Fill; Compacted Class II | C.Y. | 77,000 | | |
| 4 | Earth Fill, Class III | C.Y. | 25,000 | | |
| 5 | Additional Rolling | square (100sf) | 25,000 | | |
| 6 | Stripping; Dike Foundations | C.Y. | 38,000 | | |
| 7 | Riprap | C.Y. | 22,000 | | |
| 8 | Filter | C.Y. | 7,000 | | |
| 9 | Sand and Gravel Backing | C.Y. | 3,000 | | |
| 10 | Seeding | square (100sf) | 1,500 | | |

Total . . . . . . . . . . .$__________

## SCHEDULE (continued)

### Combination of Section B and C

| Item No. | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Excavation; Long Sault Canal | C.Y. | 12,162,000 | | |
| 2 | Earth Fill, Compacted, Class I | C.Y. | 236,000 | | |
| 3 | Earth Fill; Compacted, Class II | C.Y. | 1,392,000 | | |
| 4 | Earth Fill; Class III | C.Y. | 1,646,000 | | |
| 5 | Additional Rolling | square (100sf) | 75,000 | | |
| 6 | Stripping; Dike Foundations | C.Y. | 207,000 | | |
| 7 | Riprap | C.Y. | 193,000 | | |
| 8 | Filter | C.Y. | 35,000 | | |
| 9 | Sand and Gravel Backing | C.Y. | 33,000 | | |
| 10 | Seeding | square (100sf) | 10,200 | | |

Total . . . . . . . . . . .$

### Combination of Sections A. B and C

| Item No. | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Excavation; Long Sault Canal | C.Y. | 15,669,000 | | |
| 2 | Earth Fill; Compacted Class I | C.Y. | 236,000 | | |
| 3 | Earth Fill; Compacted Class II | C.Y. | 1,392,000 | | |
| 4 | Earth Fill, Class III | C.Y. | 1,646,000 | | |
| 5 | Additional Rolling | square (100sf) | 75,000 | | |

## SCHEDULE (continued)

### Combination of Sections A, B and C (continued)

| Item No. | Designation | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|---|
| 6 | Stripping; Dike Foundations | C.Y. | 207,000 | | |
| 7 | Riprap | C.Y. | 193,000 | | |
| 8 | Filter | C.Y. | 35,000 | | |
| 9 | Sand and Gravel Backing | C.Y. | 33,000 | | |
| 10 | Seeding | square (100sf) | 10,200 | | |

Total . . . . . . . . . .$______

NOTES: - (a) All amounts and totals given above will be subject to verification by the United States. In case of variation between unit bid price and totals shown by bidder, the unit price will be considered to be his bid.

(b) All bids must be for the entire work in each section or combination of sections and must have each blank space filled in for each section or combination of sections bid on.

(c) The quantities of each item of the bid, as finally ascertained at the close of the contract, in the units given and the unit prices of the several items stated by the bidder in the accepted bid will determine the total payments to accrue under the contract. The unit price bid for each item must allow for all collateral or indirect cost connected with it.

2. EXPERIENCE. (See Invitation for Bids, paragraph 14)

3. STATEMENT ESTABLISHING PERMANENT PLACE OF BUSINESS AND FINANCIAL STATUS. (See Invitation for Bids.)

4. PLANT TO BE USED ON THE WORK. (See Invitation for Bids and paragraph 1-16 of the specifications.)

(a) Earthwork.

(1) Excavating Equipment.

| No. | Type | Manufacturer | Capacity | Age | Condition |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
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(2) Transporting Equipment.

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(3) Embankment Equipment.

(a) Spreading and Rolling Equipment.

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(b) Miscellaneous Equipment

| No. | Type | Manufacturer | Capacity | Age | Condition |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
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| | | | | | |

5. PLANT LAY-OUT (See Invitation for Bids.) - The undersigned has attached herewith the plant lay-out prescribed in the Invitation for Bids.

6. PROGRESS CHARTS. (See Invitation for Bids.) - The undersigned has attached herewith the progress charts prescribed in the Invitation for Bids.

7. It is hereby warranted that in the event award is made to the undersigned there will be used in the performance of the work covered by the contract only such unmanufactured articles, materials, and supplies as have been mined or produced in the United States, and only such manufactured articles, materials, and supplies as have been manufactured in the United States substantially all from articles, materials, or supplies mined, produced, or manufactured, as the case may be, in the United States except as noted below or otherwise indicated in this bid or authorized in the specifications.

8. The undersigned agrees, upon receipt of written notice of the acceptance of this bid within________days after the date of opening of the bids, to execute the standard form of Government contract, in accordance with the bid as accepted, and give performance and payment bonds, with good and sufficient surety or sureties, for the faithful performance of the contract, and for the protection of all persons supplying labor and materials in the prosecution of the work, within _______days after the prescribed forms are presented for signature.

9. The undersigned agrees to begin the work within 20 calendar days after date of receipt of notice to proceed, and complete it within _______ calendar days after date of receipt of said notice to proceed.

______________________________
(Bidder)

By____________________________
(Name and Title)

______________________________
(Business Address)

Note: Read Standard Government Instructions to Bidders before preparing this bid.

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